CHAPTER 12

TANKS, TANKS CAR, AND TANK VEHICLES MAINTENANCE AND CLEANING

Section I. Storage Tanks and Tank Maintenance

USE OF STORAGE TANKS

Storage tanks are concrete, steel, and collapsible fabric containers used to store large amounts of fuel. These tanks must be large enough in size and number to hold fuel for current demands and reserve for future needs. Most storage tanks are located at tank farms. Tank farms are groups of storage tanks and pumps connected by pipelines and manifolds. These pipelines and manifolds move fuel into, out of, and between the tanks. Tank farms are part of base terminals where tankers are loaded or unloaded, intermediate terminals where fuel is stored until it is needed elsewhere, and head terminals where fuel is issued.

CONCRETE TANKS

Concrete tanks are permanent underground tanks made of reinforced cement. They are covered with a 4-foot mound of earth as shown in Figure 12-1. Most concrete tanks have manholes and ladders which provide access to the inside. Pits containing pumps and other equipment may be located nearby. Most of these tanks are coated or lined on the inside to prevent leaks and to provide a barrier between the fuel and the concrete. These tanks are difficult to clean and to repair if they develop cracks or leaks. All leaks should be reported for maintenance.

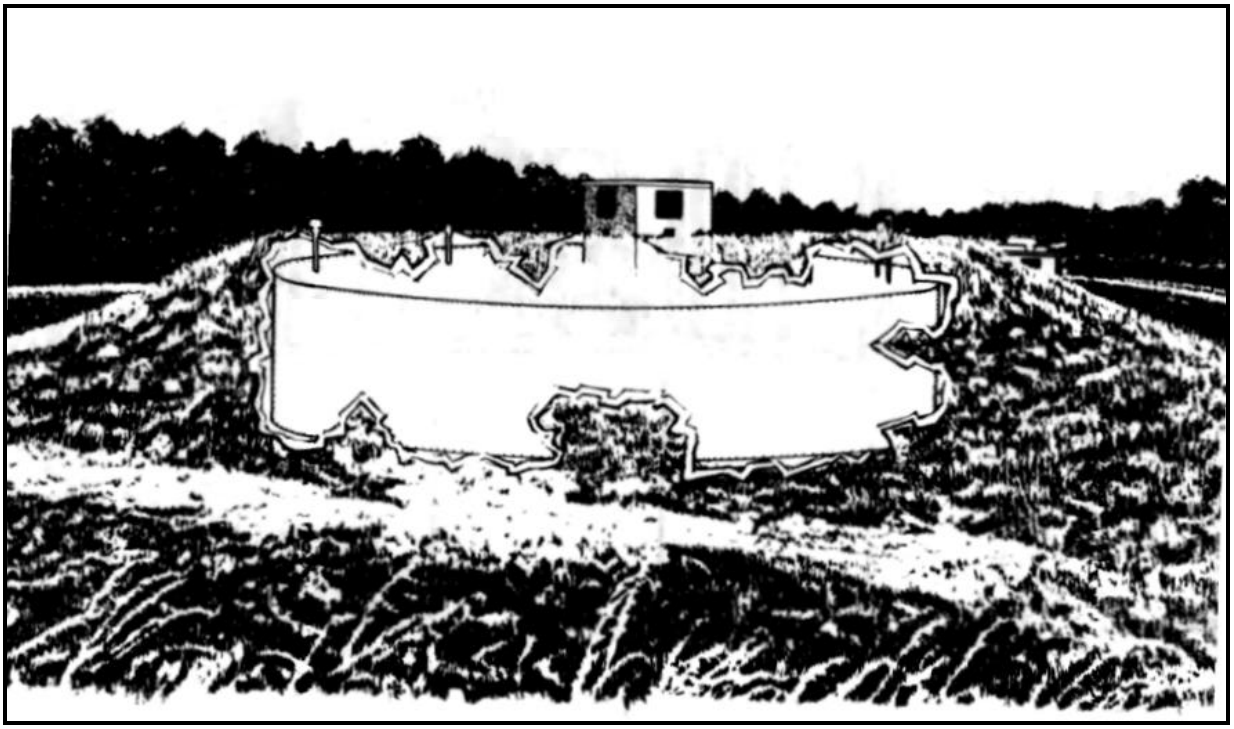

Figure 12-1. Earthen mound over concrete tank

STEEL TANKS

Steel tanks are made of metal plates called staves. These staves are bolted or welded together. Bolted tanks as shown in Figure 12-2 come in 100-, 150-, 250-, 1,000-, 3,000-, and 10,000-barrel sizes. Neoprene rubber gaskets are used to seal the edges of the staves and to prevent leaks. Bolted tanks are used aboveground. They are semi-permanent because they can be taken down and reassembled at a new location. The bolted steel cone roof is used extensively by the military. The tanks have free vents and have a high vapor loss. Welded tanks as shown in Figure 12-3, page 12-3, will hold volumes in excess of 10,000 barrels of fuel. They are built for permanent use aboveground or buried under a covering of cement or earth. Because of the construction it requires skilled personnel. Many aboveground welded tanks have floating roofs as shown in Figure 12-4, page 12-3. These roofs move up and down with the level of the fuel in the tank. This reduces the amount of vapor in the space above the fuel and lessens the chance of a fire or explosion**.** The welded cone roof tank is better suited for the storage of high volatile products than the bolted steel tank. In areas subject to bad weather conditions, floating roof tanks with permanent covers or domes have been developed for use. Aboveground bolted and welded tanks should be built on level foundations that have adequate drainage. Concrete slab or concrete ring foundations are preferred. The outside of the aboveground tanks should be painted a light color to protect them from corrosion and to reflect heat. Each tank should be surrounded by a firewall high enough to contain all the fuel in the tank in the event of a leak. As a safety measure, 1 foot should be added to the height of the firewall. There are three types of floating roofs:

- Pan. The pan type tank is a large, floating pan, slightly smaller in diameter than the tank shell. A system of flexible shoes closes the space between the edge of the roof and the tank shell.

- Pontoon. The pontoon type tank has a system of closed compartments or pontoons to increase floating stability and simplify the structure.

- Double Deck. The double deck type tank has two separate decks over the entire tank surface. It provides insulation from the sun's rays and helps to cut down on loss of product from evaporation.

Figure 12-2. Bolted steel tank

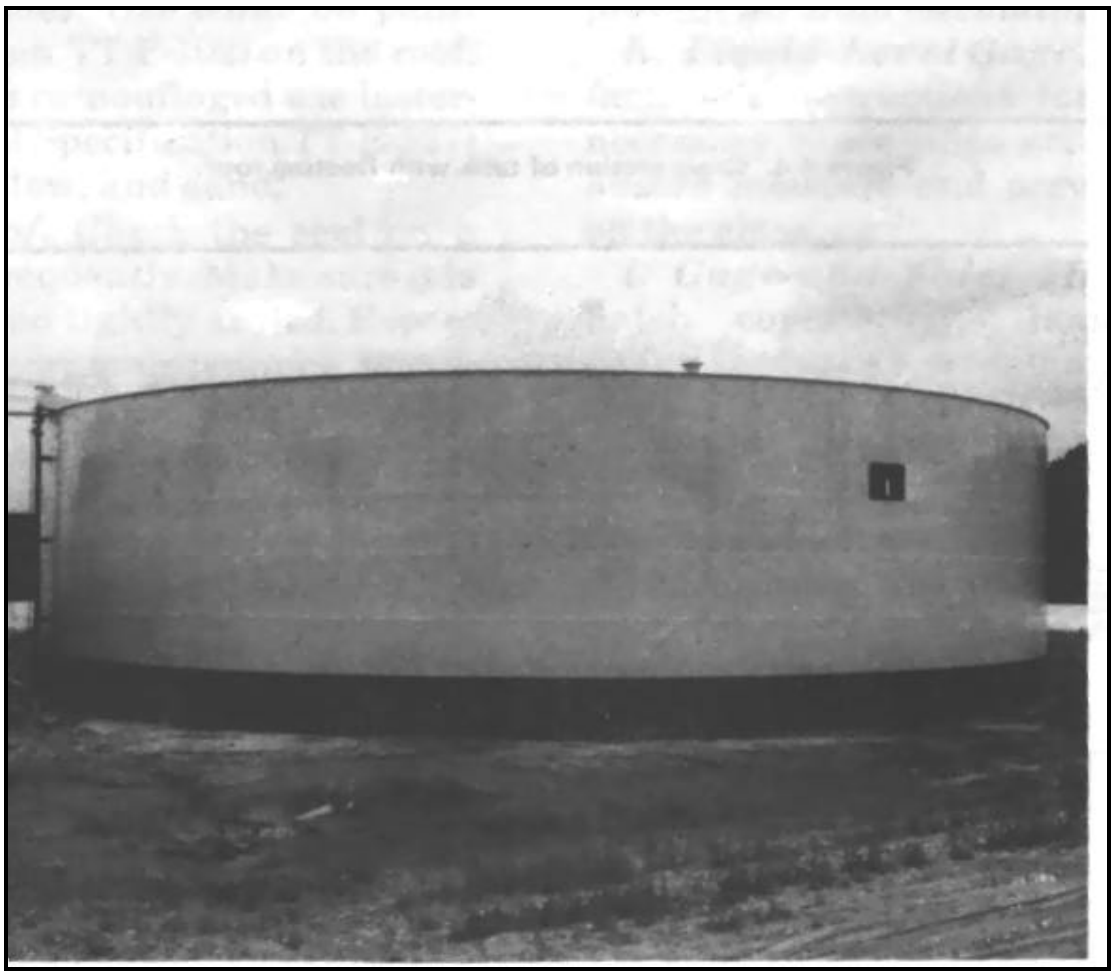

Figure 12-3. Welded steel tank

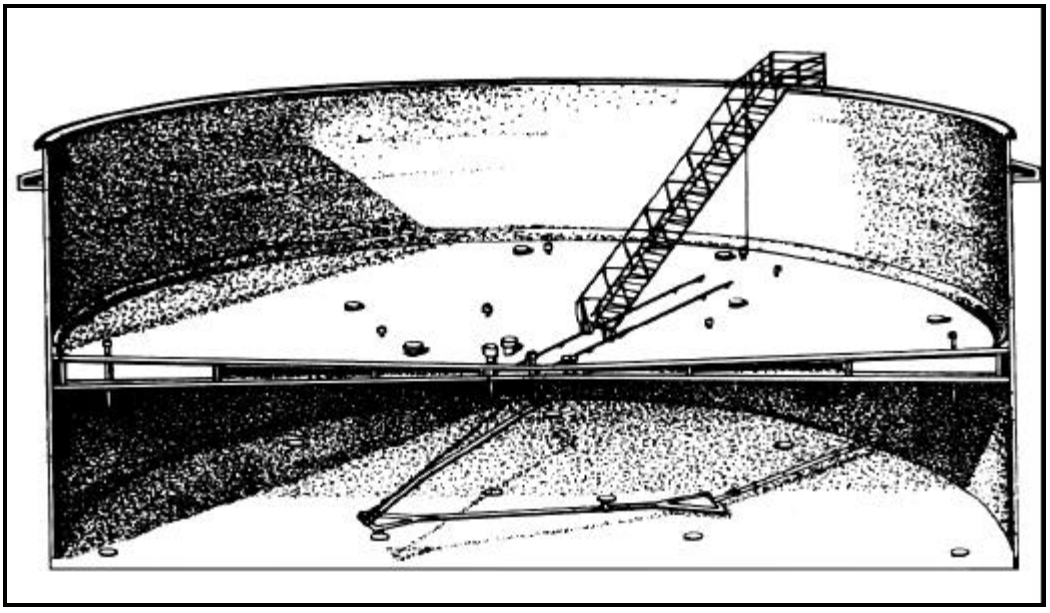

Figure 12-4. Cross section of tank with floating roof

COLLAPSIBLE TANKS.

Collapsible fabric tanks as shown in Figure 12-5 are made of elastomeric-coated nylon. They are currently available in 3,000-, 10,000-, 50,000-, and 210,000-gallon sizes. They are used for the temporary storage of fuel at beachheads, FSSPs, and tank farms. The major advantage of collapsible tanks is that they can be put into service quickly. Most of the time involved is used to prepare a graded site that is surrounded by a firewall.

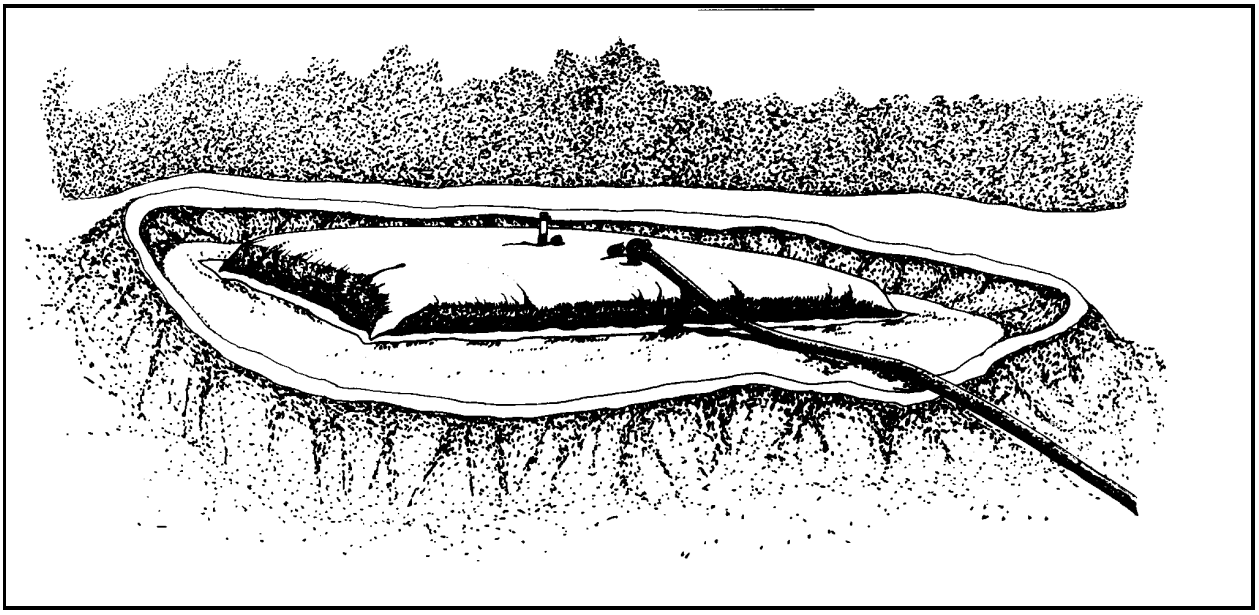

Figure 12-5. Collapsible fabric tank

INSPECTION AND MAINTENANCE OF STEEL TANKS

When product characteristics of samples exceed deterioration limits, a physical inspection must be done on operating tanks and bulk storage tank.. This inspection should take place whenever a tank's condition shows evidence of excessive interior rusting or liner deterioration and microbial problems, and the bottom sludge creates a problem as to the ability of the tank to maintain the quality integrity of the product being stored or issued. Any necessary maintenance should be performed as soon as possible. The results of the inspections and the maintenance performed on storage tanks should be recorded on DA Form 4177.

Steel Tank Exterior

Check the outside of an aboveground steel tank every month for leaks. Be aware that seeping fuel discolors paint. Repair leaks if possible. Do not try to repair a leak on the bottom of a storage tank. First determine how much fuel is being lost by checking the daily gage record and then report the leak to support maintenance.

Painted Surface

Check for rust and chipped paint on the sides of the tank every month. Check the paint on the roof every 6 months and spot paint if necessary. Do not paint the entire tank. Painting an entire tank is a support maintenance function. To spot paint areas of the tank, follow these steps.

- Clean the surface of the tank down to the bare metal with a wire brush.
- Paint the area with one coat of red lead primer (DOD-P-17545) and allow it to dry.
- Put two coats of rust-inhibiting semigloss enamel (Federal Specification TT-P-102) on the roof. If the tank has been camouflaged, use lusterless enamel (Federal Specification TT-E-527) in black, brown, yellow, and sand.

Floating Roof

Check the seal on a floating roof tank frequently. Make sure it is in good condition and tightly sealed. Report any damage to support maintenance. Check the roof daily during rainy, freezing, or snowy weather. If the seal has frozen to the tank surface, free the seal before raising or lowering the roof. Shovel snow over the side of the tank as soon as possible to prevent the collapse of the roof under the weight of the snow.

Swivel Joint Pipe Drain or Hose

Drain the water off the roof daily by opening the roof drain valve located on the tank shell at the bottom. Clean the swivel joint pipe drain or hose and the sump. Keep the pipe drain free of water during freezing weather.

Vents

Remove the screens every 6 months and clean them with dry-cleaning solvent. Check for corrosion and damage. Repair, repaint, or replace if necessary.

Pressure-Vacuum Breather Valve

Remove the valve as shown in Figure 12-6 every 6 months. Remove debris from the housing. Clean the screens with dry-cleaning solvent or compressed air. Clean pallets, guides, and seats with dry-cleaning solvent or mild liquid metal polish. If metal polish is used, take care to remove the polish completely. Lubricate stems and guides. Regrind corroded seats and pallets by placing fine grinding compound between the two parts and lightly moving the pallet back and forth on its seat. Then clean the parts as described above.

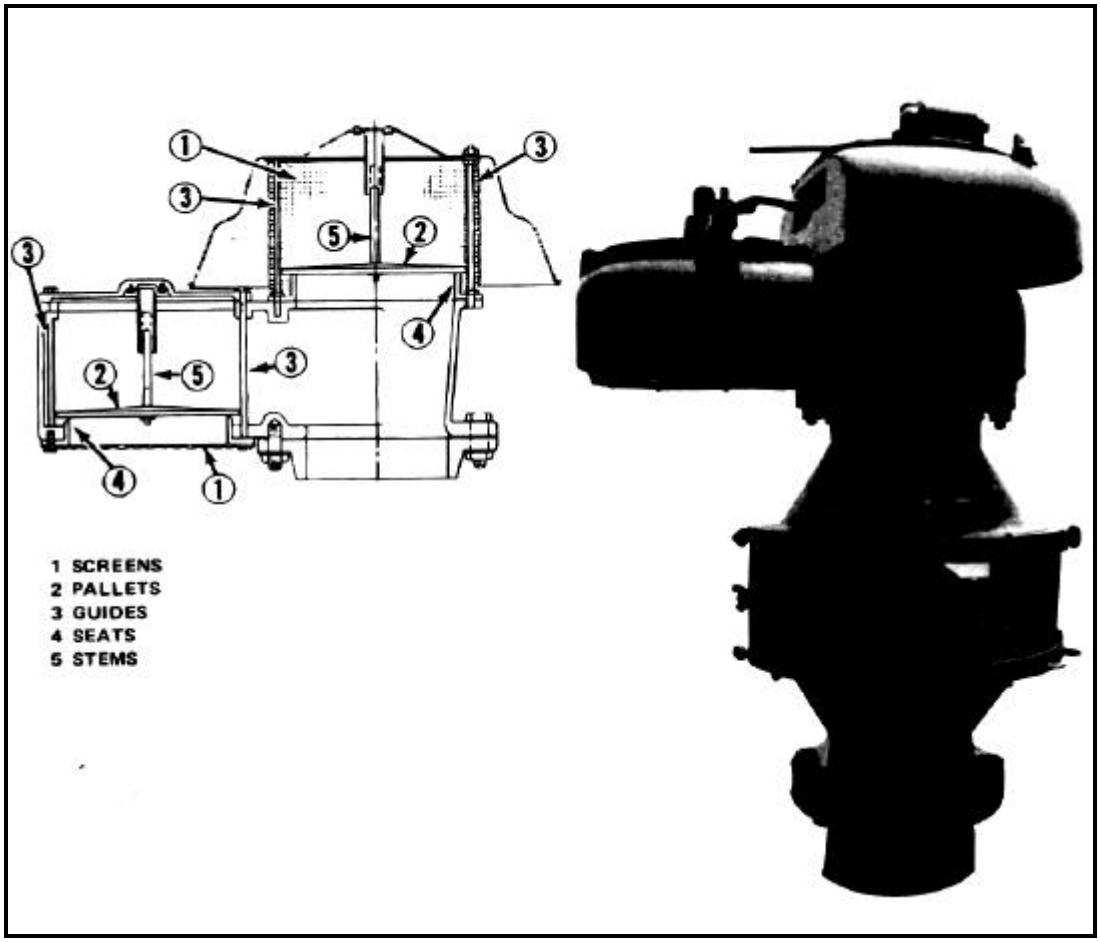

Figure 12-6. Pressure-vacuum breather valve

Flame Arresters

Inspect the outside of flame arresters as shown in Figure 12-7 every 6 months. Clean and spot paint if necessary. Flame arresters have box-shaped tube banks made of flat and corrugated metal sheets. Remove these tube banks every 6 months and clean them with dry-cleaning solvent or compressed air. Do not remove any of the metal sheets from a tube bank. To prevent damage to the tank during freezing weather, remove the entire flame arrester from the tank before the tube banks become clogged with ice and prevent air from circulating.

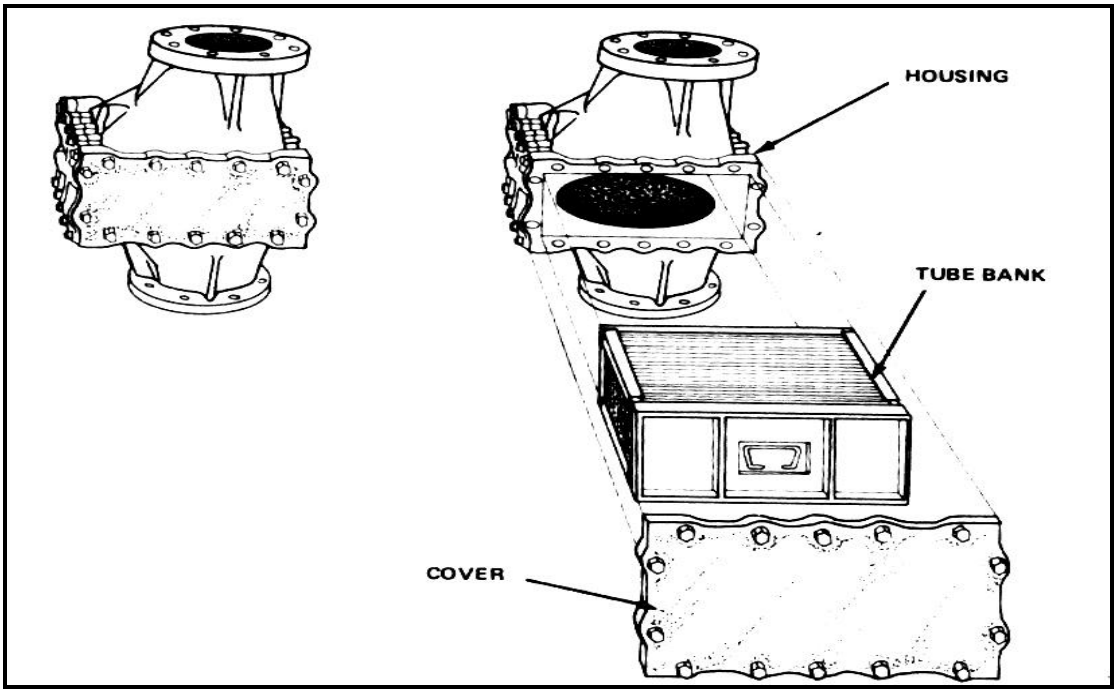

Figure 12-7. Flame arrester and tube bank

Liquid-Level Gage

Follow the manufacturer's instructions for maintenance. If necessary, place silica gel inside the gage to absorb moisture and prevent condensation on the glass.

Gage-and-Thief Hatch

Check the hatch cover for damage once a year. To replace a damaged hatch cover, remove the pins and hatch cover, put a new cover in place, and replace the pins. Check the seal on the cover once a year for cracks and damage. Replace the seal if necessary.

Manhole Cover

Check the manhole cover and gasket regularly. To replace a damaged cover or gasket, remove the pins and washers on the hinge, remove the damaged cover or gasket, put the new cover or gasket in place, and replace the pins and washers.

Water Drain Valves

Check the valves weekly for leaks. To repair a leak in a water drain valve that has a float control check valve device, unscrew the valve from the threaded flange, replace the D-ring, and screw the valve back into place. If the valve does not have a float control check valve device, pump fuel out of the tank until the level of the fuel in the tank falls below the level of the valve. Then remove the valve and replace the D-ring. If replacing a D-ring does not stop a leak, replace the entire valve.

Tank Stairways, Ladders, Handrails, Platforms, and Catwalks

Check these areas to make sure they are safe to use and that they are securely attached to the tank. Look for corrosion and broken parts. Repair, repaint, or replace them as needed. Pay special attention to hollow handrails which may have corroded from the inside. Check the tread on stairways and ladders. If it has been worn smooth, it will be slippery when wet. Check platforms and catwalks where water can collect and cause corrosion. A small hole may need to be drilled through the metal plate so that water will drain off the surface.

Tank Interior

Make a visual inspection of the inside of the tank at regular intervals (MIL-STD-457). A visual inspection is made from the cleanout door or shell manhole. The tank should be drained and ventilated to the point that fuel vapors are no longer explosive. Although it is not necessary to enter a tank to make a visual inspection, respirators should be worn during the inspection. Table 12-1 shows how often visual inspections should be scheduled.

Table 12-1. Frequency of visual inspections.

Inside of Tank Coated	Filter/Separator Used on Incoming Fuel	Frequency of Inspections
No	No	Every year
No	Yes	Every 2 years
Yes	No	Every 2 years
Yes	Yes	Every 3 years

REPAIR OF LEAKS IN WELDED STEEL TANKS

A leaking seam in a welded tank can be repaired by rewelding the seam. Such welding can be done by skilled welders. See TM 9-237. The tank must first be drained, freed of vapor, and cleaned. After obtaining a permit from the safety officer to weld, follow these steps.

- Move fire-fighting equipment near the tank.
- Make sure the welders wear protective clothing and shoes.
- Remove paint from the surface of the repair area with a wire brush.
- Make sure the welders use the right size and type of electrodes.
- Repaint the repair area after the leak has been fixed.

REPAIR OF LEAKS IN BOLTED STEEL TANKS

The method used to repair a leak in a bolted steel tank is determined by the size and location of the leak. In an emergency, a leak caused by a small hole in a stave can be stopped by driving a wooden leak plug into the hole. Small holes can also be covered with patch bolts that are inserted from the outside and tightened with a wrench. Large leaks in the metal plate that require replacing one or more staves are beyond the scope of organizational maintenance. Leaks at vertical seams can sometimes be stopped by tightening the nuts at the leaks seam with a wrench. Leaks at the chimes (horizontal edges) can usually be repaired by installing additional bolts or by replacing the gasket material. To install additional bolts, drill holes between the bolts of the leaking chime. Then use new washers, insert a bolt into each new hold, and securely tighten a nut on each bolt. To install new gasket material, take out enough bolts in the leaking chime to remove the gasket material at and around the leak. Then cut out the damaged section of gasket material, and chalk the area with putty. Using new gaskets and washers on the bolts, put the bolts back in and tighten the nuts.

NOTE: Before many of the repairs can be made, the tank must be drained to a level below the leak. If repairs must enter a tank to make or finish repairs, the tank must be completely drained. No one should enter the tank until the fuel vapor level is below the explosive limit. Small repairs which take a short time to complete, such as

tightening a nut on a bolt, may then be made. Repairers must wear protective clothing and respirators. The tank should be vapor freed for longer repairs.

INSPECTION AND MAINTENANCE OF COLLAPSIBLE TANKS

Collapsible tanks should be inspected frequently, and any necessary maintenance performed as soon as possible. Service to collapsible tanks should be recorded on DA Form 2404. TM 5-5430-210-12 has detailed instructions on maintenance, troubleshooting, and repairs. See Figure 12-8, page 12-9, to locate parts of the tank.

Inspect and perform maintenance on the following:

- Surrounding Area. Check the ground around the tank. Remove sticks, rocks, and sharp objects that could damage the tank or cause a leaks.
- Tank Exterior. Check the tank for tears, holes, loose handles, and leaks. Make the repairs if possible.
- Fill and Discharge Parts. Check the fittings, elbows, and holes for damage and signs of a leak. If necessary, clean the parts with dry-cleaning solvent. Replace worn gaskets and packing.
- Vent Pipe. Check the coupling, dust cap, and vent pipe for damage. Look for signs of a leak. Replace worn gaskets. Clean all parts with dry-cleaning solvent. Make sure the dust cap can operate freely to relieve pressure.
- Drain. This fitting is located on the bottom of the tank at the lower end. Check the fitting and hose for leaks. Replace worn packing and clean all parts with dry-cleaning solvent.
- Control Valves. Check the fill and discharge valves. Also, check the drain control valve. Look for leaks. To repair a leak, replace worn gaskets and packing. Clean all parts with dry-cleaning solvent. Look for bent stems. Repair or replace an entire valve if necessary.
- Tank Interior. Sludge can build up in the bottom of a collapsible tank. Remove this sludge and clean the tank periodically to prevent fuel contamination. Also clean the tank before using it to store a different fuel. To clean the inside of a tank, follow these steps.

  - Drain the fuel from the tank.
  - Remove the access plate on the filler and discharge fitting.

WARNING

Do not inhale fuel vapors.

  - Dispose of sludge in a way that is not harmful to the environment as given in paragraph on sludge disposal, page 12-25.

WARNING

Do not allow fuel or sludge to come in contact with the skin.

  - Flush the tank with water.
  - Replace the access plate.
  - Open the drain and roll up the tank to remove as much water as possible.
  - Unroll the tank and close the drain.
  - Pump in a few gallons of fuel and roll up the tank again to wet the walls with fuel to prevent cracking. Use the new fuel if service is being changed from one fuel to another.
  - Unroll the tank and put it back into use.

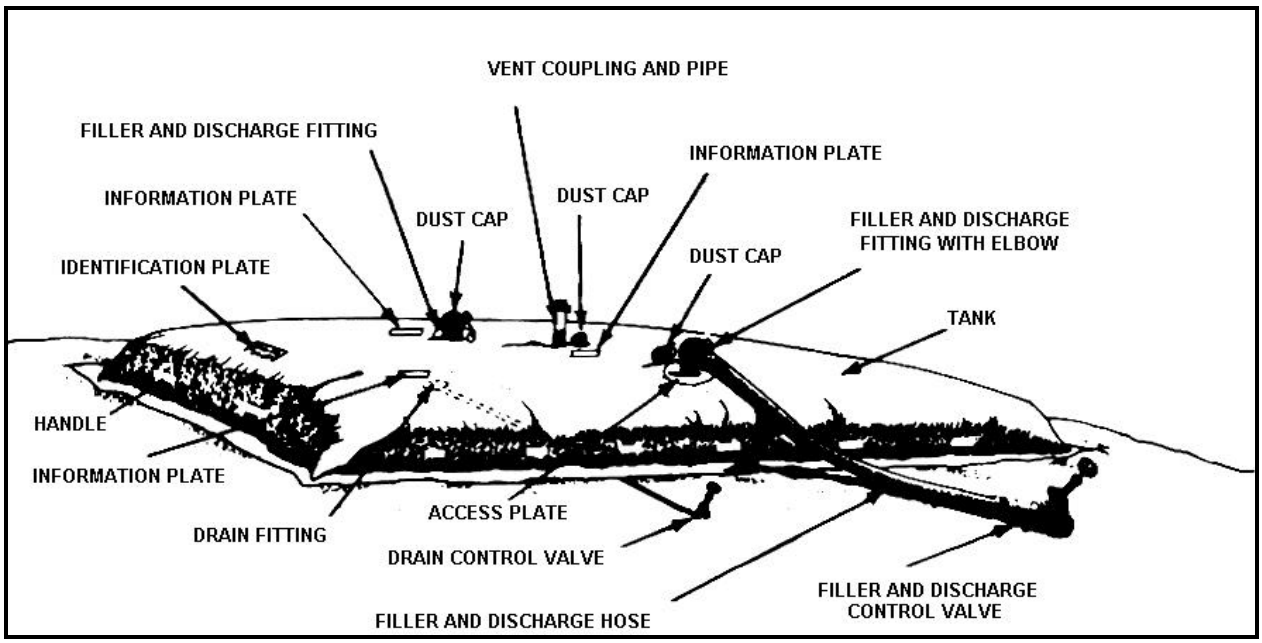

Figure 12-8. Parts of a collapsible tank

REPAIR OF COLLAPSIBLE TANKS

The method used to repair a collapsible tank is determined by the size of the hole or tear in the tank. A sealing plug is used to repair a hole up to 3/8 inch wide. A sealing clamp is used to repair holes larger than 3/8 inch and tears up to 7 inches. Type I repair kit as shown in Figure 12-9 contains sealing plugs. Type II repair kit as shown in Figure 12-10, page 12-10, contains sealing clamps and sealing plugs.

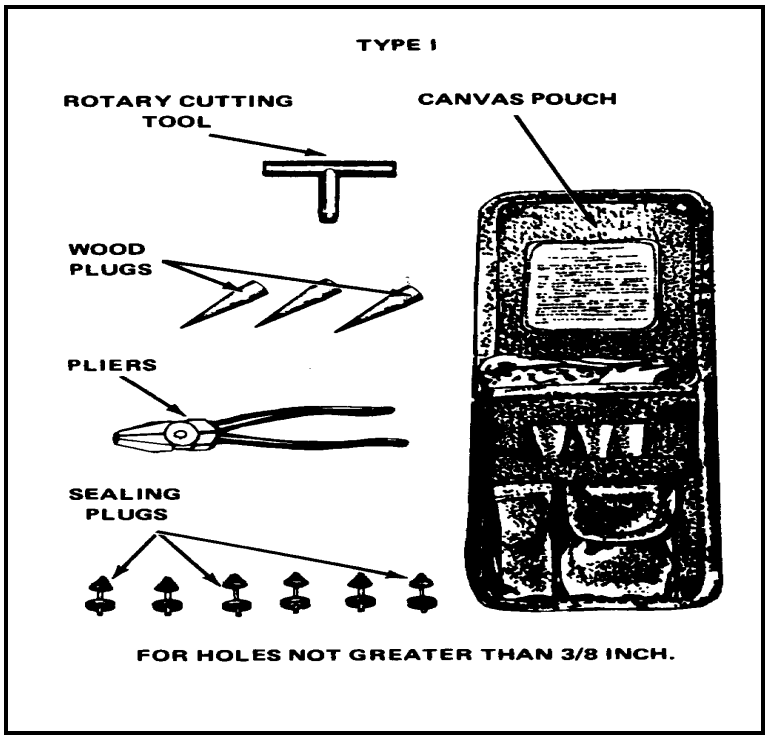

Figure 12-9. Type I repair kit

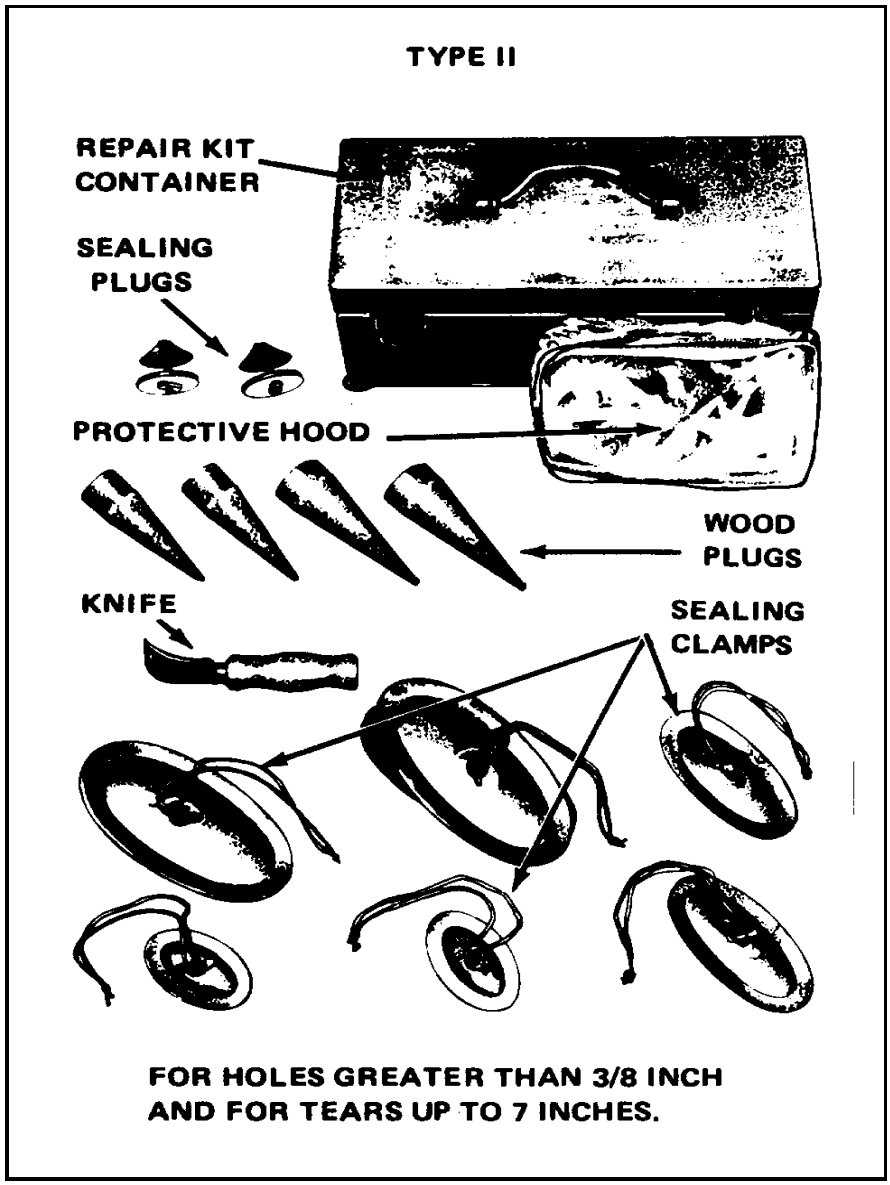

Figure 12-10. Type II repair kit

Sealing Plug Repairs

To repair a tank with a sealing plug, follow these steps:

- Put on the protective hood and rubber gloves.
- Put a wooden plug into the hole to stop the leak until repair materials are ready to use.
- Remove the wooden plug and use a rotary cutter to cut a clean edge around the hole as shown in Figure 12-11, page 12-11.
- Push the cone-shaped end of the sealing plug through the hole.
- Pull the sealing plug up tight against the inside wall of the tank.
- Tighten the nut on the sealing plug with pliers and cut off the excess shank.

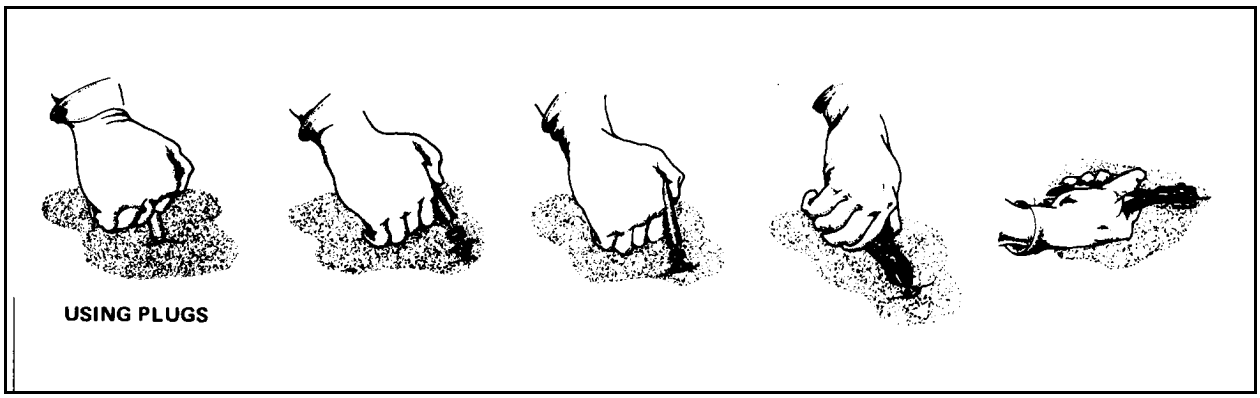

Figure 12-11. Repairing a collapsible tank using plugs

Sealing Clamp Repairs

To repair a tank with a sealing clamp, follow these steps.

- Put on the protective hood and rubber gloves.
- Put a wooden plug into the hole if possible to stop the leak until a sealing clamp has been selected.
- Select the correct size sealing clamp. The shorter side or width of the bottom plate of the clamp should fit through the hole or tear. It may be necessary to enlarge the hole or tear slightly by using a knife to insert the bottom plate as shown in Figure 12-12.
- Fold the hinged stud down and put the bottom plate through the tear.
- Straighten the stud and rotate the bottom plate so that the longer side or length of the bottom plate is in the same direction as the length of the tear.
- Slide the upper plate over the stud and tighten the wing nut.

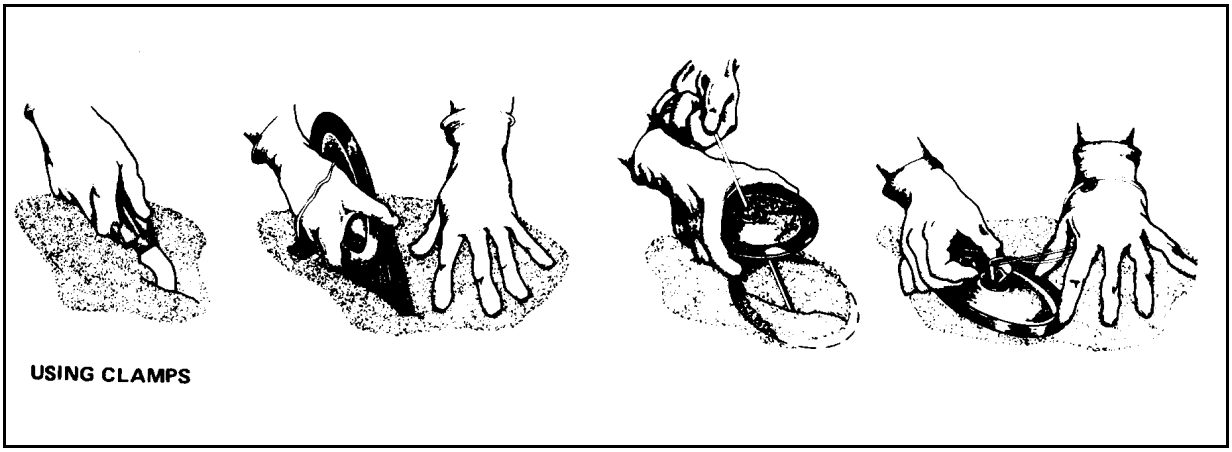

Figure 12-12. Repairing a collapsible tank using clamps

Section II. Tank Cleaning Precautions and Equipment

NEED FOR PLANNING AND TRAINING BEFORE TANK CLEANING

During any fuel-handling operation, fuel vapors can accidentally ignite, causing a fire or an explosion. The chance of this occurring during tank cleaning is especially high. There are other health and physical hazards involved which make tank cleaning dangerous work. The job can be performed without death, injury, or property damage if the cleaning operation is carefully planned step by step and if members of the cleaning detail receive extensive training. A working knowledge of the dangers involved and hands-on experience with the safety equipment are essential. At least two members of the cleaning detail must be trained and tested in first aid. The training must include cardiopulmonary resuscitation and treatment for vapor inhalation. In addition, the cleaning detail supervisor must prepare a fire plan for the tank in the event fuel vapors are ignited.

WARNING

Prior to confined space entry, all requirements under the OSHA Confined Space Entry Program must be met.

PREVENTION OF FIRE AND EXPLOSION

The danger of fire and explosion during tank cleaning operations comes from the possible ignition of fuel vapors. The best way to prevent a fire or explosion during tank cleaning, therefore, is to eliminate all sources of ignition and to reduce the concentration of vapors to a point where they will not ignite. Fuel vapors can be ignited when they come in contact with a source of ignition. This is possible only when a certain amount of fuel vapor has been combined with air. A mixture of 1 to 8 percent fuel vapor and air will ignite at once when it comes in contact with a spark or flame. The mixture will burn if it is ignited in an open area where the hot gases produced have room to expand. The mixture will explode if it has ignited in a closed space where the heat and gases have no place to go. A mixture with less than 1 percent fuel vapor is too lean to ignite. A mixture with more than 8 percent fuel vapor is too rich to ignite. Care must be taken when opening a tank with a mixture too rich to ignite. The too-rich mixture could quickly change to an ignitable mixture after opening the tank. The hydrogen sulfide vapors found in crude oil tanks are also combustible. They can ignite when the hydrogen sulfide content of the tank is between 4.3 percent and 46 percent. So that an explosion or fire does not occur during tank cleaning operations, the concentration of fuel and hydrogen sulfide vapors must be reduced as quickly as possible to levels that will not ignite. The best way to reduce the concentration is to circulate air through the tank. The air weakens or dilutes the vapor concentration. Eventually the air displaces the vapors completely. Care must then be taken to make sure the vapors are not allowed to collect in low areas outside the tank. These vapors could be ignited outside the tank, and the fire could spread back to the tank. The other sources of ignition are covered in Chapter 2 of this manual.

HEALTH HAZARDS

The atmosphere inside a tank that has been removed from service is hazardous to health. The danger lies in several areas.

Presence of Fuel and Sludge

Physical contact with fuel and sludge can cause serious damage to the skin. Fuel and sludge remove natural oils, leaving the skin chapped and cracked. These cracks are avenues for disease and infection to enter the body. Areas of skin wet with fuel or sludge must be washed at once with soap and water. The cleaning detail must wear white clothing so that fuel stains can be spotted easily. They must also wear rubber gloves and boots to protect their hands and feet.

Presence of Fuel Vapors

Fuel vapors, especially gasoline and jet fuel vapors, are narcotic. Inhaling these vapors can slow the central nervous system to the point that breathing stops. In addition, inhaling even small amounts of these vapors can irritate the lungs and respiratory system, causing pneumonia or leaving a person open to other respiratory diseases. The poisonous or toxic limit is 500 parts per million. The cleaning detail must wear respiratory equipment while working until testing the fuel vapors produces a reading at or below that limit. Workers may then work in the tank up to 8 hours without respiratory equipment. This does not apply to tanks that have been used to store leaded fuels.

Presence of Tetraethylead

Tetraethylead is a poisonous liquid. Contact with tetraethylead can result in lead poisoning. Therefore, great care must be taken when entering a tank that has been used to store leaded fuel. Inhaling the fuel vapors can be fatal. Cleaning details must wear respiratory equipment when working in leaded fuel storage tanks. The equipment must be used even after the tank has been tested and declared vapor free because inhaling dust particles from scale on the walls can also result in death. Workers must also avoid direct contact with leaded sludge since lethal amounts of lead can easily be absorbed through the skin. This sludge is dangerous even after it has been removed from the tank, so great care must be taken with its disposal. The tank is not safe until it has been cleaned down to the bare metal.

Presence of Hydrogen Sulfide

Exposure to hydrogen sulfide can cause death by paralyzing the respiratory system. Victims become unconscious and never regain consciousness. Mild exposure damages the eyes. Hydrogen sulfide, which is found in crude oils with a high sulfur content, can usually be detected by its rotten egg odor. Be cautious never to use the sense of smell to determine whether or not hydrogen sulfide is present in a tank. Use a piece of moist lead acetate paper instead. If hydrogen sulfide is present in the tank, it will blacken the paper. The concentration of hydrogen sulfide vapor can be measured by a hydrogen sulfide detector. The toxic level is 20 parts per million. It is not safe to work in a tank without respiratory equipment until readings are at or below that level.

Lack of Oxygen

Normal air contains 21 percent oxygen. A concentration of less than 7 percent is dangerous. Fuel vapors in addition to being narcotic, displace oxygen in a tank. Respiratory equipment must be used during tank cleaning until a tank has been cleared of fuel vapors. Care must also be taken when entering a clean tank that has been closed for a long time. The metal surface inside may have rusted, using up the oxygen inside the tank. No one should enter such a tank until fresh air has been allowed to circulate inside the tank. For more on health hazards, see Chapter 2 of this manual.

PHYSICAL HAZARDS

In addition to fire and health hazards, there are physical hazards involved in tank cleaning. Members of the cleaning detail must take precautions to avoid the following:

- Collapse of ladders, scaffolds, and stairways. Make sure they are in good condition and securely attached to the tank.
- Collapse of thin roof sections. Use wooden planks to distribute weight evenly when working on a roof.
- Accidental pumping of fuel into the tank. Make sure lines to the tank are blanked off with blind flanges or figure eight blinds. Do not depend on closed valves.
- Tools and objects dropping from above. Handle tools carefully. Do not throw them and do not drop them through the roof manhole. Make sure fixtures inside the tank are securely attached to the tank and cannot be knocked down. Lower the swivel joint drain pipe to prevent accidental release during cleaning operations.
- Slipping on wet floors and tripping over hoses, pipes, and fittings. Use extreme caution when moving around inside the tank.

•Colliding with other workers or tank supports in a poorly lighted tank. Make sure lighting is adequate. Workers must wear white so that they can be seen easily.

SAFETY EQUIPMENT SET

The safety equipment set as shown in Figure 12-13 contains nearly everything necessary to provide physical and respiratory protection for two members of a cleaning detail. No one must enter a tank without having some experience handling and operating the components of the set.

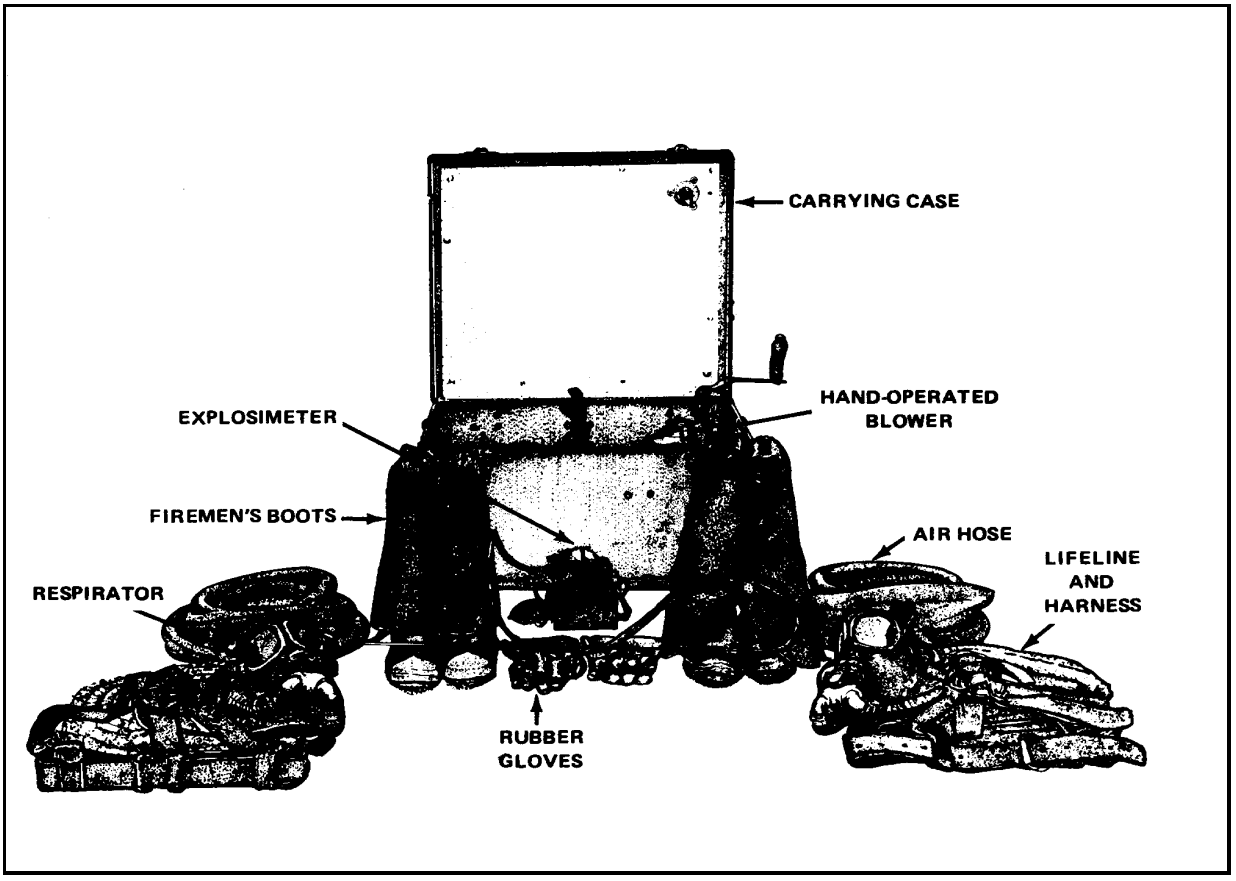

Figure 12-13. Safety equipment set

Respirators and Air Hoses

Two respirators and four rubber air hoses are in the set. Respirators are face masks which attach to air hoses. The respirators must be approved by the Bureau of Mines. When connected to a blower, respirators provide an independent supply of fresh air to the wearer. They must be worn at all times inside tanks that were used to store leaded fuel. They must be worn inside all other tanks until the tanks have been tested and found to be worn inside clean tanks that have been closed for a long time. The following precautions must be taken with respirators and air hoses:

•Inspect respirators before each use. Also inspect them before they are stored.

•Make necessary repairs at once to ensure that the respirators are ready for use at all times.

•Test respirators before each use. To test a respirator, cut off the air supply to the mask for a few seconds by covering the end with the palm of the hand as shown in Figure 12-14, page 12-15. If there are no leaks and the straps have been adjusted properly, the face piece will collapse against the face.

- When attaching respirators to air hoses, make sure the connections are tight and that gaskets are being used to provide an airtight seal. Replace worn gaskets if necessary.
- Never remove respirators while inside a tank. The tank may have been vapor free, but the face pieces could still be contaminated.
- When entering a tank, lift the air hoses over the edge of the manhole. Pad the edge of the manhole to prevent damage to the hoses.
- When a member of the cleaning detail enters a tank, someone must be assigned to tend the air hose and to keep the worker under observation at all times. The attendant must be dressed and outfitted to enter the tank to rescue an unconscious or injured worker.
- Do not yank, twist, or step on air hoses.
- When inside a tank, do not wrap air hoses and lifelines around anything that could make an emergency exit difficult.
- Wash each face mask and air hose with soap and water at the end of each day and let them dry before storing.

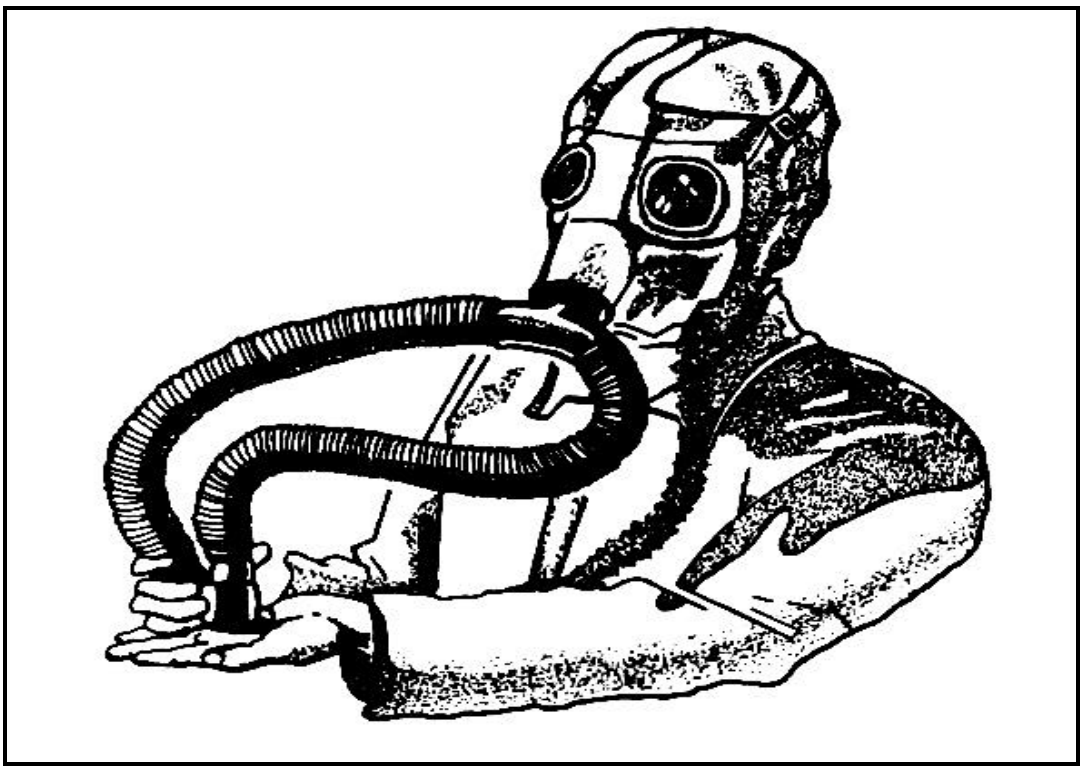

Figure 12-14. Testing a respirator

Hand-Operated Blower

The blower is mounted inside one of the two carrying cases for the set. The handle is detachable and mounts on the outside of the case. The blower is operated with the lid closed. When the handle is turned, fresh air is fed through the air hoses to the respirators. The blower must be set up on the windward side of the tank to make sure the cleaning detail is receiving fresh air. The blower must be attended at all times while workers are wearing respirators.

Leather Harnesses and Lifelines

Two leather harnesses and lifelines are in the set. Workers wear harnesses into a tank when they wear respirators. The lifelines attach to the back of the harnesses. Lifelines are tended by the same workers tending the air hoses. Lifelines are used to trace workers inside a tank and to pull unconscious workers to safety. All harnesses and lifelines must be cleaned and allowed to dry before they are stored.

Firemen's Boots and Rubber Gloves

Four sets of boots and gloves are provided with the safety equipment set. The boots and gloves are fuel resistant. The boots have reinforced toes and nonslip soles. Boots and gloves must be worn in the tank at all times.

Explosimeter

One explosimeter (combustible gas indicator) as shown in Figure 12-15, two sampling lines, and a probe are in the safety equipment set. An explosimeter is used to determine how explosive and toxic the atmosphere is inside a tank. The explosimeter must be approved for use by the Bureau of Mines.

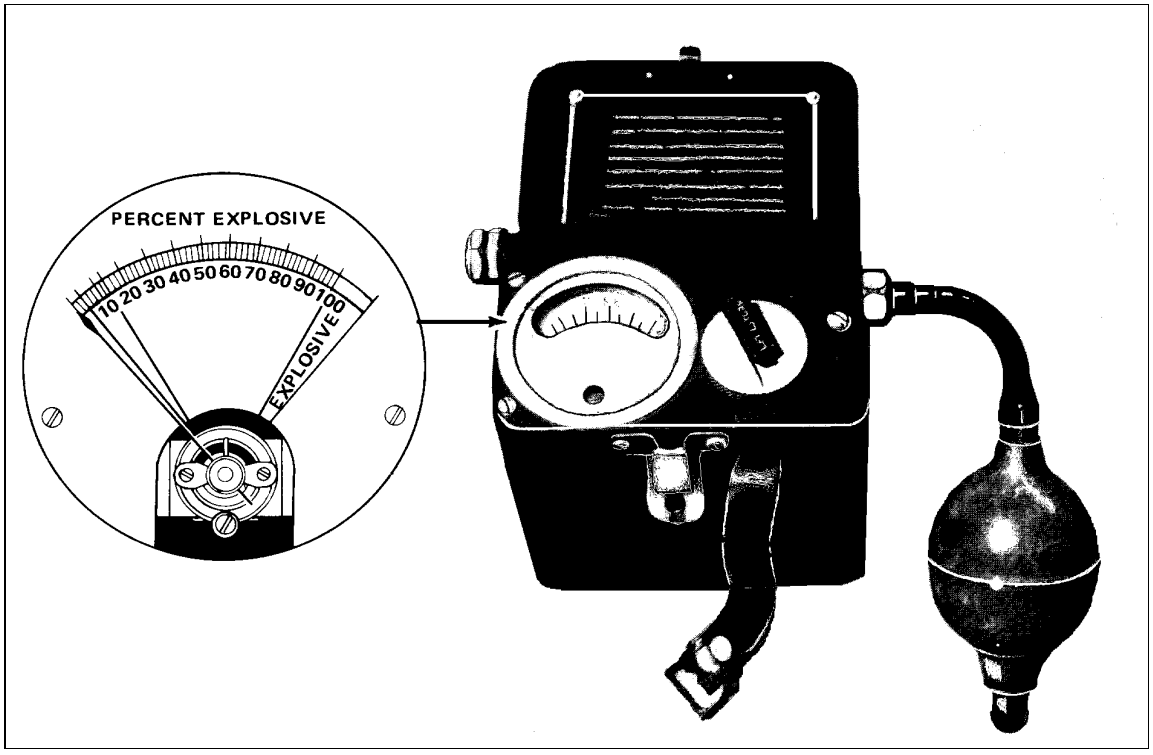

Figure 12-15. Explosimeter

•Operation. Squeezing the rubber suction bulb draws an air sample through a probe and sampling line to an analyzer unit. A filament inside the unit burns the fuel vapors in the sample. The flame produced is protected by a flame arrester so that fuel vapors inside the tank are not ignited. The filament is part of an electrical circuit supplied with current by dry cell batteries. Burning the fuel vapors increases the temperature of the filament. As a result, there is an increase in the electrical resistance of the filament. This in turn creates a voltage imbalance which moves the needle on the dial of the explosimeter--the greater the concentration of fuel vapors, the higher the reading.

•Readings. An explosimeter does not measure what percentage of the volume of a tank is made up of fuel vapors. It measures how explosive the contents are in a tank. A concentration of 1 percent fuel vapors is explosive. A reading of 100 percent on an explosimeter means that at least 1 percent of the contents of the tank consists of fuel vapors which makes the contents 100 percent explosive. No one should enter a tank when explosimeter readings are at or above 100 percent. A reading between 14 percent and 100 percent means that the tank is not safe because of toxic vapors. Workers must not go into the tank unless they are wearing respirators. A reading between 4 percent and 14 percent means that workers could go into the tank without respiratory equipment but only for a very short time. To be on the safe side, such trips should be discouraged. A reading of 4 percent on the explo-

simeter converts to approximately 500 parts per million, the toxic limit for fuel vapors. Members of the cleaning detail can work in storage tanks for 8 hours at a time without respiratory equipment when the explosimeter reading is 4 percent or less.

NOTE: This does not apply to tanks that have been used to store leaded fuels.

- Directions for Use. To use an explosimeter, follow these steps.
  - Obtain six fresh 1.5-volt dry cell batteries and put them in the explosimeter.
  - Turn on the explosimeter in a vapor-free area outside the tank.
  - Flush the explosimeter with fresh air by squeezing the bulb five times. Add two squeezes for every 10 feet of line if a sampling line is being used.
  - Move near the open manhole of the tank and take a sample of the air inside the tank by squeezing the bulb until the reading on the explosimeter remains steady. Wear the proper protective equipment.
  - Note the reading. It shows the concentration of combustible vapors in the sample.
  - Flush the explosimeter with fresh air after each use.
  - Turn the explosimeter off and remove the batteries before storing the unit.
  - Service the unit, if necessary, by following the directions in the manufacturer's manual.

HYDROGEN SULFIDE DETECTOR

The cleaning detail must determine what kind of fuel was stored in a tank before they start any cleaning operation. Tanks that were used to store crude oils must be tested for the presence of hydrogen sulfide. If the cleaning detail is unable to determine what kind of fuel was stored in a tank, the tank must be tested for hydrogen sulfide to be on the safe side. Respiratory equipment must be worn during the test. A hydrogen sulfide detector as shown in Figure 12-16 consists of a suction bulb, a glass detector tube, and a frame with a scale. To use a hydrogen sulfide detector, break off the ends of the glass detector tube and insert the tube in the frame. Squeeze the bulb 10 times to draw a sample into the tube. The reading on the scale is shown in percent. A content of 4.3 percent to 46 percent hydrogen sulfide is explosive. The toxic limit is 20 parts per million or .002 percent. Members of the cleaning detail must not go into a tank until the percent of hydrogen sulfide is less than 4.3 percent. They must not remove respirators until the tank is vapor free.

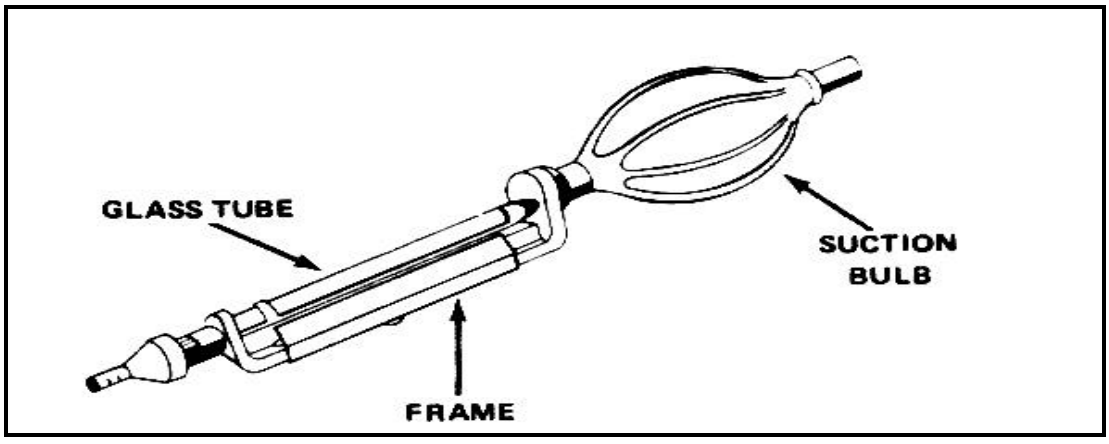

Figure 12-16. Hydrogen Sulfide Detector

FIRE EXTINGUISHERS

A fire caused by ignited vapors is a class B fire. Loaded stream, foam, carbon dioxide, or dry chemical fire extinguishers may be used on a class B fire. The extinguishers are available in hand and wheel units. Members of the cleaning detail should know how to operate these fire extinguishers. Fire extinguishers are effective only in the first stages of a fire, so the cleaning detail should be trained to act quickly. See Chapter 2 for more information about classes of fire and fire extinguishers.

PROTECTIVE CLOTHING AND EQUIPMENT

Members of the cleaning detail must wear clean, white cotton coveralls when they go inside a tank. White must be used because it is easily seen inside a dim tank and it shows fuel stains easily. Cotton must be used because it cuts down on the generation of static electricity. All protective clothing must be laundered at the end of each workday. To protect the team from falling objects and debris, they must wear safety helmets when they go inside the tank. When respirators are no longer needed, they must wear goggles to protect their eyes from loose scale and cleaning solvents in the tank.

Section III. Storage Tank Cleaning

RESPONSIBILITY

Vapor freeing, decontaminating, and cleaning tanks are organizational maintenance activities with two exceptions. Cleaning fixed tanks to apply rust proofing and coatings to the inside surface is the responsibility of the facilities engineer. Cleaning fixed tanks that are a part of motor pools, service stations, and aircraft fueling systems is also the responsibility of the facilities engineer. A tank should not be cleaned unless it is absolutely necessary. It is necessary to drain, vapor free, and clean a tank when the following actions take place.

Inspections

MIL-STD-457 states that a storage tank should be inspected periodically by physical entry. This means that the inspectors must go inside the tank to do the inspection. The tank should be cleaned before such an inspection takes place. When these inspections are made depends on whether or not the inside of the tank is coated and whether or not incoming fuel is pumped through a filter/separator. See Table 12-2 for more information.

Table 12-2. Frequency of physical entry inspections.

Inside of Tank Coated	Filter/Separator Used on Incoming Fuel	Frequency of Inspections
No	No	Every 3 years
No	Yes	Every 4 years
Yes	No	Every 4 years
Yes	Yes	Every 6 years

Repairs

A storage tank should be drained, vapor freed, and cleaned for any repairs to the tank, inside or outside, that require welding or the use of tools that could ignite vapors. The tank should also be cleaned whenever it is necessary to enter the tank to make lengthy repairs.

Fuel Contamination

A storage tank should be cleaned as often as necessary to maintain fuel quality. MIL-STD-457 states that a sample should be taken from an active tank at least every 30 days. A sample should be taken from a less active tank at least every 180 days. If laboratory tests show that the fuel is being contaminated by rust and dirt in the

tank, the tank should be cleaned. If tests show that the fuel is being contaminated by bacteria, the tank and lines should be flushed with fresh clean water. If bacteria reappears in later tests, the tank should then be cleaned.

Sludge Buildup

Dirt, gums, waxes, and resins settle out of fuel in a storage tank. This sludge collects on the bottom of the tank. When the sludge hardens, it forms a heel which cannot be pumped out. This heel remains in the tank when the tank is emptied and filled. The heavier or darker the fuel, the more sludge is left behind. Fuel pumped in on top of this layer of sludge can become contaminated. When bottom samples show fuel contamination or when gagging reveals that too much sludge has built up, the tank should be cleaned.

Change of Product

A tank should be used to store only one kind of fuel so that quality can be maintained. If the service of a tank has to be changed from one fuel to another, the tank should be cleaned before pumping in the new fuel. See MIL-HDBK-200, Table V, for guidelines.

NOTE: The service of a tank may be upgraded by gradually pumping in fuel of a higher quality than that previously pumped into the tank. Fuel contamination will always be a result of such an upgrade. This should be taken into consideration before a decision is made to use this method to change service. This method should never be used to make radical changes. For example, the method should not be used to change tank service from diesel fuel to AVGAS.

Removal of Tank from Service

If a decision is made to take a storage tank out of service for longer than 4 months, the following actions should be taken:

- All concrete tanks should be cleaned.
- Steel tanks used to store fuel oil, diesel fuel, and lubricating oil should be cleaned. They should then be coated with the same product they contained. This will preserve the metal.
- Steel tanks used to store gasoline, jet fuel, and kerosene should be cleaned and then coated with general-purpose lubricating oil (Federal Specification VV-L-800) to preserve the metal.
- Steel tanks to be dismantled should be cleaned and coated with general-purpose lubricating oil.

NOTE: It is not necessary to coat a tank that was taken down to move it to a new site for reassembly.

Reactivation of Tank

If a decision is made to put an inactive tank back into service, the following actions should be taken:

- Steel tanks that have stood empty for sometime should be cleaned to remove the rust which may have formed on the inside.
- Steel tanks that were coated with lubricating oil should be cleaned before they are used to store gasoline, jet fuel, or kerosene.
- Inactive tanks that were ballasted with water or fuel should be cleaned to remove rust and sludge.

FACILITIES ENGINEER DUTIES

When there is a reason to justify cleaning a tank, the facilities engineer is notified. The facilities engineer should--

- Determine the need to enter any tank that has been used to store leaded fuel.
- Determine the need to enter any other tank capable of holding 1,000 or more barrels of fuel.
- Make sure there is a safety equipment set available for use.

•Obtain the services of a safety engineer experienced in tank cleaning safety. The safety engineer should be present when any tank containing leaded fuel is entered. The safety engineer should also be present when any tank capable of holding 1,000 or more barrels of fuel is entered.

•Request medical advice from The Surgeon General (AR 200-1), if necessary.

•Obtain the services of a contractor to clean a tank if local demand for tank cleaning is so infrequent that the local work force cannot maintain a level of expertness (AR 420-49). The contractor should be instructed to provide all the equipment and take all the precautions necessary to protect life, health, and property.

CLEANING DETAIL SUPERVISOR DUTIES

The cleaning detail supervisor oversees all cleaning operations. The cleaning supervisor should--

•Gather the following information:

••Kind of fuel stored in the tank.

••Reason for cleaning the tank.

••Condition of the tank and any repairs to be made.

••Amount of corrosion and sludge present in the tank.

••Last date the tank was cleaned and how well it was cleaned.

•Train the cleaning detail. This training must include instruction on the dangers involved in tank cleaning, the use of the safety equipment set, and the safety precautions that apply to tank cleaning.

•Prepare a fire plan for the tank. Everyone should know what is expected of him in the event of a fire or explosion.

•Delegate various jobs to specific members of the cleaning detail.

•Make sure at least two members of the detail have recently been trained and tested in cardiopulmonary resuscitation.

•Determine whether or not every member of the detail is in good physical condition and able to working in the tank. Workers who are tired or sick will develop more problems inside the tank.

•Inspect all safety equipment to make sure it is in good condition and ready for use.

•Make sure fire-fighting equipment is nearby.

•Arrange for the safe disposal of sludge. See AR 200-1.

•Contract, if necessary, for the use of a vacuum truck to remove sludge and haul it to a disposal area.

•Furnish the environmental engineer with information on the tank and sludge disposal to obtain a safety permit.

•Examine the area around the tank to make sure all sources of ignition have been removed.

•Make sure the tank is isolated before starting cleaning operations.

•Be present during cleaning operations to provide instruction and guidance.

•Make sure no one enters the tank until vapor readings are in the safe zone.

•Tell members of the cleaning detail to leave the tank if they smell fuel vapors.

TOOLS AND EQUIPMENT

In addition to the safety equipment and clothing already described, other tools and equipment are needed to clean a tank. Make sure the following items are on hand before starting cleaning operations:

•Blind flanges or Figure eight blinds to provide positive shutoff to the tank.

•Pump to move sludge from tank bottom to tank vehicle.

•Tank vehicle or vacuum truck to carry sludge to disposal site.

- Air eductor or ejector to raw fuel vapors out of the tank.
- Blowers or fans to drive fuel vapors out of the tank.
- Shovels, scrapers, wire brushes, buckets, and wheelbarrows.
- Long-handled push brooms, scrub brushes, squeegees, and mops.
- Towels, washcloths, and bath soap for each member of the cleaning detail.
- Water hose and nozzle.
- Disinfectant for face masks.
- Clean rags and airtight metal cans to store oily rags until they can be destroyed.
- First aid kits.
- Wrenches and tools necessary to blank off the tank, enter the tank, and tighten loose tank accessories.
- Warning signs to post during tank cleaning.
- Sign-painting kit and yellow paint to stencil tank after cleaning.
- Ladders and scaffolding to reach upper areas of the tank shell.
- Detergents, cleaning solvents, and kerosene.

ISOLATING A TANK

Before vapor-freeing and cleaning operations can begin, a tank should be isolated. The tank should be completely cut off from the rest of the terminal and pipeline system. There should be no way to accidentally pump fuel into the tank. There should also be no way for fuel vapors to drift back into the tank after it has been vapor freed. To isolate a tank, follow these steps.

- Use the lowest tank connection and pump or drain as much fuel as possible out of the tank. If necessary, pump in enough water to cover the tank bottom. What fuel is left and the sludge that had not hardened will float on top of the water. Pump this liquid sludge to a tank vehicle and then draw off the water. Do not allow oily water to spill on the ground. Be aware that some tanks, especially underground ones, may have permanently installed sump pumps for removing liquid sludge. Some may even have their own sludge disposal systems to pipe sludge to a disposal area.

NOTE: Never pump water into a concrete tank.

- Close the valves outside the firewall on all lines going to and from the tank. Attach a sign to each valve, warning workers not to open the valves.
- Drain and flush all the lines into the tank.
- Break all lines and remove the valves nearest to the tank. Replace the valves with either blind flanges or figure eight blinds as shown in Figure 12-17, page 12-22. Make sure the solid half of the figure eight blind is down in the line. If figure eight blind holders have already been permanently installed near the tank, it is not necessary to remove the valves. Reverse the blinds so that the solid half closes off the line. All blank ends and blinds should be strong enough to withstand any pressure that might be exerted in the line. Respirators should be worn when blanking lines to tanks which were used to store leaded fuels and crude oils.

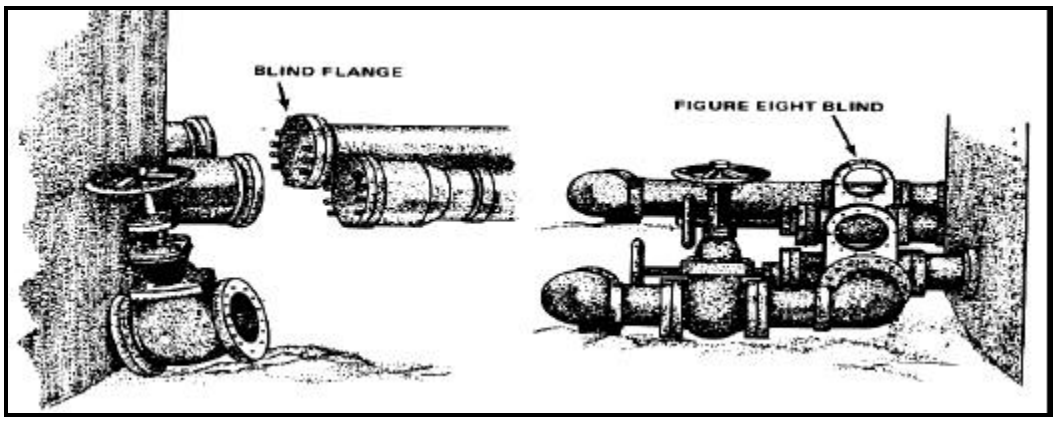

Figure 12-17. Blanking off a tank with blind flanges or figure eight blinds

VAPOR FREEING A TANK

Vapor freeing is actually the complete replacement of fuel vapors in a tank with fresh air. A tank is usually considered vapor free when the concentration of fuel vapors is below the toxic and combustible levels. Vapor freeing is a dangerous operation. Workers who open the manholes and cleanout doors of leaded fuel or crude oil tanks should wear respirators. No one should be in the area around the tank during vapor freeing except for those who approach the tank from time to time to conduct vapor tests. Several methods are used to vapor free tanks. Some methods are better than others. The method used depends on the kind of tank being cleaned and the situation.

Natural Ventilation

Natural ventilation, or airing, is the easiest method to use. Its main advantage is that it uses natural forces. It require little or no equipment and no outside power source. However, there are several disadvantages to this method. First it takes longer than other methods. The concentration of vapors inside the tank is explosive and toxic for a longer period of time. Vapors may collect at ground level outside the tank creating another hazard. Second, this method is not practical for underground tanks because of the lack of natural circulation. To ventilate a tank naturally-

- Remove the roof manhole cover.
- Remove the tank shell manhole cover or cleanout door.
- Allow air to circulate freely through the tank.
- Take vapor readings periodically. Do not start sludge removal until the tank is vapor free.

Forced Ventilation

Forced ventilation uses an outside force to direct the flow of air into the tank. This speeds the vapor freeing process. This is the most commonly used method. Two methods are used to force ventilate a tank.

- Blower or fan method. A blower or fan usually installed in the tank shell manhole or cleanout door is used to blow fresh air into the tank. Fuel vapors escape through the roof manhole. The blower or fan, may be steam-turbine, gasoline-engine, or electric-motor driven. Gasoline-powered units should be located away from the tank on the windward side. They should be equipped with spark arresters. Canvas ducts are used to carry the air to the tank. Electric-motor driven units should be explosion proof. To use a blower or fan--

  - Open the tank shell manhole or cleanout door.

  - Set up gasoline-engine powered units away from the tank and lay canvas ducts on the ground to the tank opening. Mount other units in the tank opening. When using this method to vapor free underground tanks, attach the blowers to pipes leading to the tank bottom or to ducts or hoselines. These ducts or hoselines are fed through roof openings to the tank bottom.

••Remove the roof manhole cover.

••Start the blower and ventilate the tank until vapor readings are in the safe zone.

•Air ejector or eductor method. An air ejector, or eductor, is used to draw fuel vapors out of the top of the tank. The unit is installed in the roof manhole. Fresh air is allowed to enter through the tank shell manhole or cleanout door. To use an air ejector or eductor--

••Open the roof manhole and install the unit.

••Operate the unit to create a pressure differential between the inside and outside of the tank. Use the low setting at this point to avoid creating a vacuum.

••Once a pressure differential has been established, open the tank shell manhole or cleanout door. This allows fresh air to be drawn into the tank. In underground tanks, open pipes leading into the bottom of the tank.

••Operate the unit at full speed until the tank is vapor free.

Steam Ventilation

This method uses steam to displace fuel vapors. Steam ventilation has many disadvantages. Its use is discouraged except in tanks where iron sulfide is known to be present. On large diameter tanks, steam is not effective; however, it is effective on tank trucks and rail cars. The disadvantages are--

•It generates static electricity which could ignite vapors.

•It is a slow method. Producing enough steam to displace fuel vapors in a large tank is difficult.

•The temperature must be at least 170° F to prevent condensation. This temperature is difficult to maintain in cold weather.

•Steam damages the linings of coated tanks and causes cracks in concrete tanks. It should never be used to vapor free a concrete tank.

Water Displacement

This method uses water to take the place of fuel vapors in the tank. Fuel vapors exit as the tank is filled to overflowing. The oily water produced by this process has to be treated before disposal. Water displacement is practical for small tanks only. It should not be used in areas where water supplies are limited.

VAPOR TEST

Periodic vapor tests are made during vapor-freeing operations. They are made with an explosimeter and, if necessary, a hydrogen sulfide detector. The tests are made to check on the progress of the vapor freeing. Vapor tests are also conducted during tank-cleaning operations to make sure the tank is safe for members of the cleaning detail. To conduct a vapor test--

•Read the manufacturer's manuals and the paragraphs on explosimeter and hydrogen sulfide detector in this section.

•Wear a respirator and approach an open cleanout door or tank shell manhole. Insert the probe through the door as shown in Figure 12-18, page 12-24. Take the first reading in the area where vapors are leaving the tank. Do not enter the tank at this time.

•Step inside the tank to take readings when the readings from the opening fall to 14 percent. Hold the probe about 1 foot above the sludge. Turn off fans, blowers, and eductors while testing to get a true sample of the air in the tank.

WARNING

If samples are also being taken with a hydrogen sulfide detector, do not enter the tank until readings from the door are at or below the 4.3 percent explosive limit for hydrogen sulfide.

•Take samples often at various points inside the tank. Leave the tank between tests. Flush out the explosimeter with fresh air and reset at 0. Put a new glass tube in the hydrogen sulfide detector for each test.

•Repeat the tests until explosimeter readings are at or below the toxic limit of 4 percent. If samples are also being taken with a hydrogen sulfide detector, repeat the tests with the detector until readings are at or below the toxic limit of .002 percent.

•Continue to take samples after members of the cleaning detail have entered the tank to start sludge removal operations. Additional fuel vapors may be trapped in the sludge. These vapors will be released when the sludge is disturbed. If readings reach dangerous levels, members of the cleaning detail should leave the tank. They should not reenter the tank until readings are again in the safe zone.

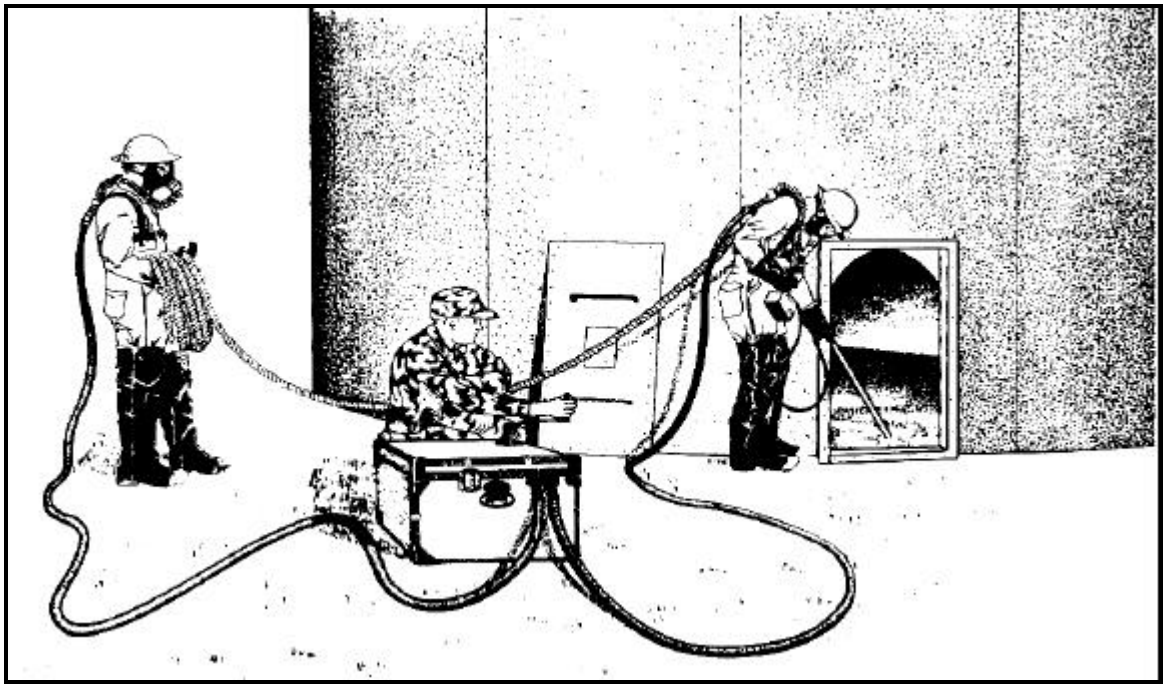

Figure 12-18. Vapor testing at cleanout door

CLEANING OPERATIONS

After a tank has been declared vapor free, members of the cleaning detail can usually enter the tank to begin cleaning operations. Some underground steel tanks may not be entered. These tanks should be cleaned using the method described in the paragraph on cleaning uncoated tank cars and tank vehicles, page 12-8**.** To clean tanks that do allow entry--

•Stencil a warning sign near the entrance to the tank if the tank was used to store leaded fuel. Wear respirators in the tank and use forced ventilation until the tank has been cleaned down to the bare metal.

•Before starting to work, inspect the inside of the tank for loose fixtures and repair the tank if necessary. Lower the swivel joint drain pipe to the tank floor.

•Use a high-pressure water hose to dislodge sludge, loose rust, and scale.

•Continue to take vapor tests. Leave the tank if readings show toxic concentrations of fuel vapors. Since it takes more time to leave an underground tank than an aboveground tank, an increase in the concentration of fuel vapors in an underground tank should be detected quickly.

•Lay a suction hose in the tank and use a pumping assembly to pump liquid sludge to a tank vehicle as shown in Figure 12-19. If a vacuum truck is being used, the pumping assembly is not necessary.

•Brush, sweep, or scrap the remaining sludge into piles and shovel it into buckets or wheelbarrows.

•Use wire brushes and scrapers to remove rust and scale from the uncoated surface of tank walls and floor. Use scaffolds or ladders to get to out-of-reach areas.

•Dispose of the sludge and debris.

•Clean the tank, fixtures, and supports. If necessary, drill small holes at the bottom of hollow structures and supports. Flush them from the top with water and allow to drain.

•Scrub the walls and floor with kerosene, cleaning solvent, or detergents, if necessary. Do not damage tank coatings.

•Rinse the walls and floor with water. Mop up all water and wipe dry with lint-free rags.

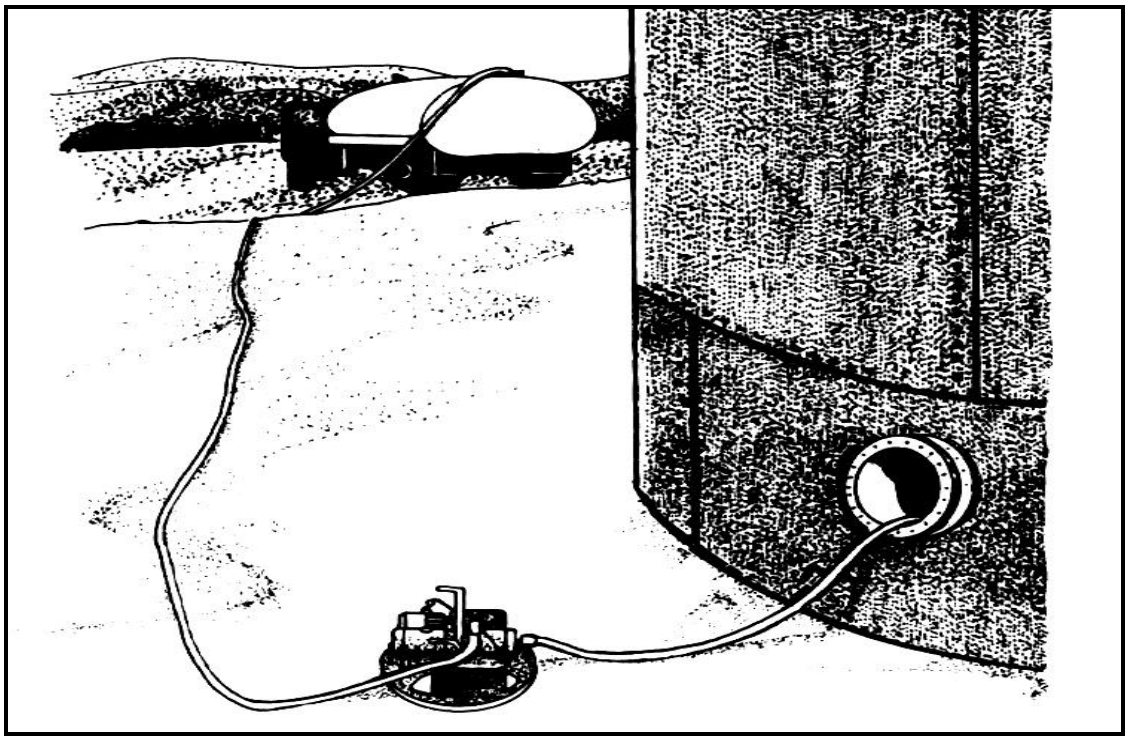

Figure 12-19. Pumping sludge to tank vehicle

SLUDGE DISPOSAL

The cleaning detail supervisor should arrange for the disposal of the sludge. All activities should be coordinated with the environmental engineer whose job it is to consider the effect or impact the disposal of the sludge will have on the environment. The method used to get rid of the sludge should not damage the environment or harm humans or animals (AR 200-1). For these reasons, sludge cannot be buried or carelessly dumped on the ground.

Unleaded or Nonhydrogen Sulfide Sludge

Sludge that does not contain lead, hydrogen sulfide, or other harmful chemicals can be disposed of by farming or weathering.

•Farming. Sludge can be farmed at selected sites. These sites should be level, well drained, well ventilated, and sunny. The sludge should be hauled to the site, evenly distributed on the ground, and plowed in with the topsoil. Later the land can be used to grow crops.

•Weathering. Sludge can be weathered at selected sites similar to those used for farming. An even layer of sludge 3 inches deep should be spread on the ground with hoes, rakes, and shovels. The area should be roped off and warning signs put up. The sludge should be left undisturbed for 4 weeks (or longer if the temperature is below freezing). The rope and sign can be taken down after the weathering is complete. The sludge can then be left there, or it can be hauled away.

Leaded or Hydrogen Sulfide Sludge

Sludge that contains lead, hydrogen sulfide, or other harmful chemicals can be disposed of by controlled burning or by depositing it at specified sites.

•Controlled burning. Harmful sludge can be burned in high-intensity heat furnaces that do not give off emissions.

•Depositing at specified site.

•Sludge can be taken to hazardous materials disposal sites. These sites are specially designated areas which have been set aside permanently for the disposal of dangerous substances such as nuclear wastes and toxic chemicals. The disposal sites must also be approved by EPA. All trucks used to transport sludge must be approved by state and federal agencies and a certificate issued for each vehicle.

AFTER-CLEANING OPERATIONS

Certain tasks should be done when the cleaning detail finishes mopping up in the tank. The job is not complete until these final tasks are done.

Tools and Equipment

Dispose of the rags and brooms used to clean leaded fuel and crude oil with the sludge from these tanks. Thoroughly clean all other tools and equipment with soap and water. You can use kerosene if necessary. Disinfect face masks. Allow all pieces in the safety equipment set to dry before storing them.

Pumping Assembly

To clean the pump assembly--

•Put the end of a suction hose into a barrel or drum of clean water. Attach the hose to a water faucet or couple the hose to a water hose.

•Start the pump and if necessary, turn on the water. Run the pump until the pump and the hose have been thoroughly flushed with water. Dispose of the water in a way that is not harmful to the environment.

•Put the end of the suction hose into a drum or container of solvent. Flush the pump and the hoses with 1 or 2 gallons of solvent. Drain the solvent from the pump and hoses.

Stenciled Sign

Use yellow paint to stencil the cleaning date on the tank near the tank shell manhole or cleanout door.

Tank Ballast

Ballast or weight steel tanks that are being taken out of service in hurricane areas to prevent them from being blown away. Ballast empty steel tanks in flood areas to prevent them from floating away.

NOTE: Ballasting is not a common practice. It should be done only if past experience has shown it to be necessary. Light fuels or water with a rust inhibitor can be used for ballast. Water should not be used as ballast in areas where there is a chance it will freeze. Also, if other ballast is available, water should not be pumped into tanks which will be used to store gasoline, jet fuel, or kerosene.

Hygiene

At the end of each work day and at the end of the job, make sure all members of the cleaning detail bathe with soap and water and change to clean clothes.

DA Form 4177

Complete DA Form 4177. Enter the cleaning date and any other important facts.

Section IV. Tank Car and Tank Vehicle Cleaning

RESPONSIBILITY FOR INSPECTING AND CLEANING

Tank cars and tank vehicles should be inspected before each use according to MIL-HDBK-200. The inside of the tank, including the dome, should be free of rust, scale, dirt, and sludge before new fuel is loaded. These inspections should be made by those responsible for loading the fuel. Organizational maintenance personnel are responsible for cleaning the inside of tank cars and tank vehicles, whenever necessary, to prevent fuel contamination. They are also responsible for cleaning tank cars and tank vehicles for a change in service or for repairs that could ignite vapors.

SAFETY PRECAUTIONS

The same dangers that are present during the cleaning of bulk storage tanks are present during the cleaning of tank cars and tank vehicles. Cleaning detail members should be familiar with the safety equipment and follow the same safety precautions described in Section II of this Chapter.

CLEANING UNCOATED TANK CARS AND TANK VEHICLES

Some tank cars and all tank vehicles have uncoated steel interiors. These tank units should be vapor freed and cleaned using steam. Steam cleaning should also be used to clean underground steel tanks that do not allow entry. To clean a tank with steam--

- Move the tank car to a bypass or spur track. Move the tank vehicle to an open area outdoors. Set the brakes. Lock derails in place at each end of the tank car. Chock the wheels of the tank car or tank vehicle.
- Remove all sources of ignition in the area. Do not start the engine of a tank vehicle during cleaning operations.
- Put up signs warning of the danger of tank cleaning.
- Drain the tank car or tank vehicle of all fuel.
- Arrange for a supply of steam.
- Obtain or make a steam spray nozzle and cover plate as shown in Figure 12-20, page 12-28.
- Contact the environmental engineer and arrange for the disposal of sludge. See AR 200-1.
- Place a container under the tank car or tank vehicle to catch sludge. If necessary, have more containers available.
- Remove the dome or manhole cover.
- Bond the steam nozzle to the tank shell with a bare copper wire. Check the rails under the tank car for correct bond and ground as shown in Figure 12-21, page 12-29. To ground the track vehicle-
  - Drive a grounding rod about 3 feet into the ground. Soak the area around the rod with water to get a better ground.

••Unwind the ground cable from the tank vehicle. Attach the cable clip to the grounding rod as shown in Figure 12-22, page 12-29.

•If the tank car or vehicle has only one compartment**,** steam the tank for an hour. Check the tank outlet. If the steam of condensation and liquid sludge is still heavy, continue to steam until the flow of sludge stops. If the tank car has more than one compartment, steam clean each one until sludge no longer flows from the outlet. Allow the tank to cool.

•Insert the pole of an explosimeter through the dome or manhole. Test for vapor concentration. Start steaming operations again if the tank is not yet vapor free.

•Look inside the tank when it is vapor free to determine whether or not there is enough sludge left to justify entering the tank to remove it. Use an explosion-proof light or flashlight.

•Wear protective clothing and respirators when entering the tank. Shovel the sludge into buckets and remove the buckets through the dome or manhole as shown in Figure 12-23, page 12-30. Lower a water hose inside and use it to flush any remaining sludge through the tank outlet to a container.

•Climb out of the tank and replace the steam nozzle and cover plate. Turn the steam on and insert the siphon hose into a container of solvent. Place the solvent container under the tank outlet to recycle the solvent through the tank several times. Shift the nozzle to reach all sides of the tank. After the tank has been sprayed with solvent, move the siphon hose to a container of clean water to rinse the walls and floor. Remove the steam nozzle and cover plate. Allow the tank to cool before reentering.

•Flush all the lines on the tank vehicle. Clean the filter/separator and line strainer.

•Dry the inside of the tank with lint-free rags.

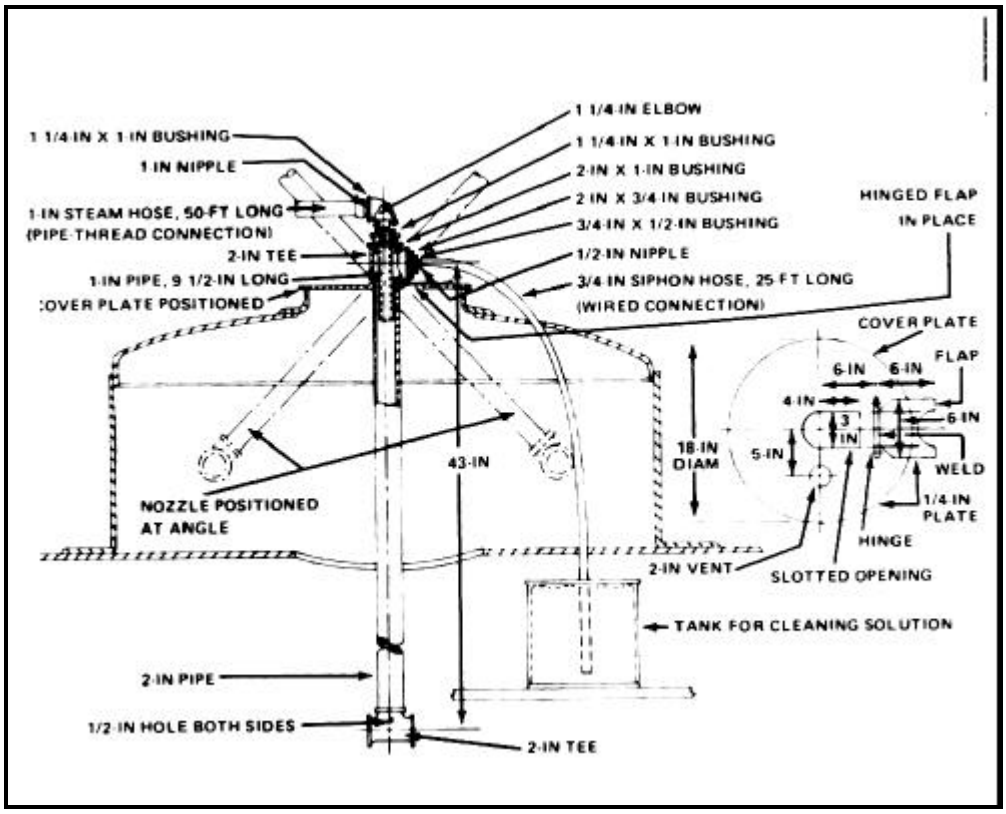

Figure 12-20. Steam spray nozzle and cover plate

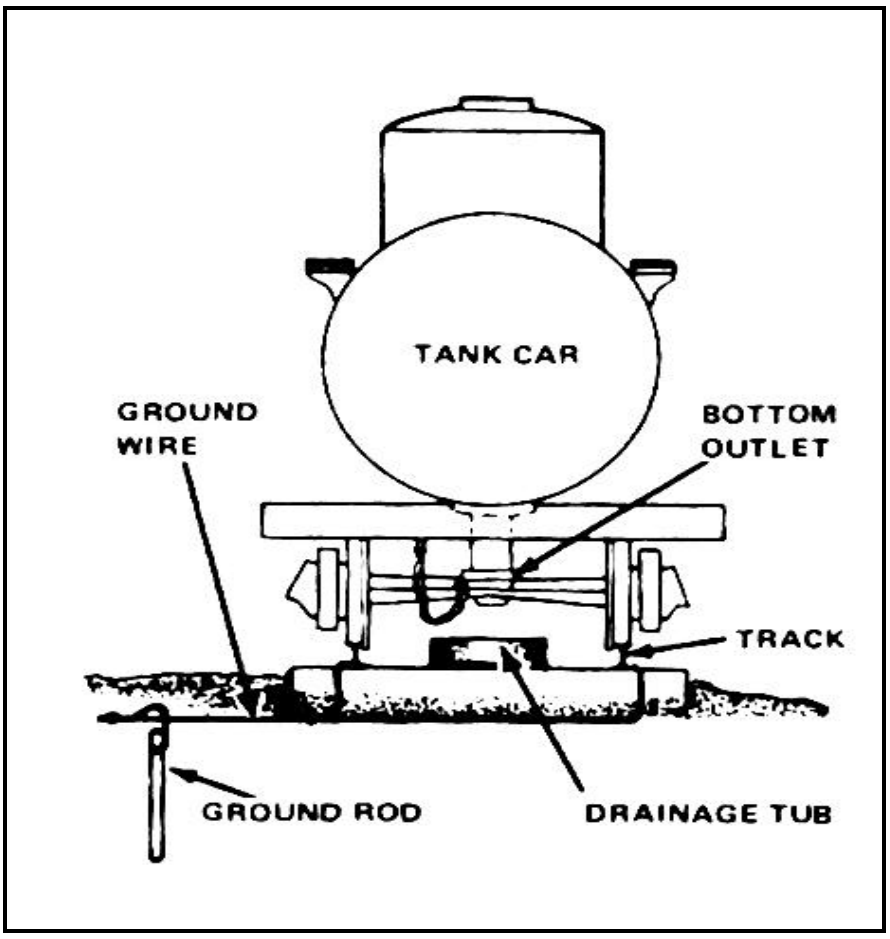

Figure 12-21. Grounding a tank car

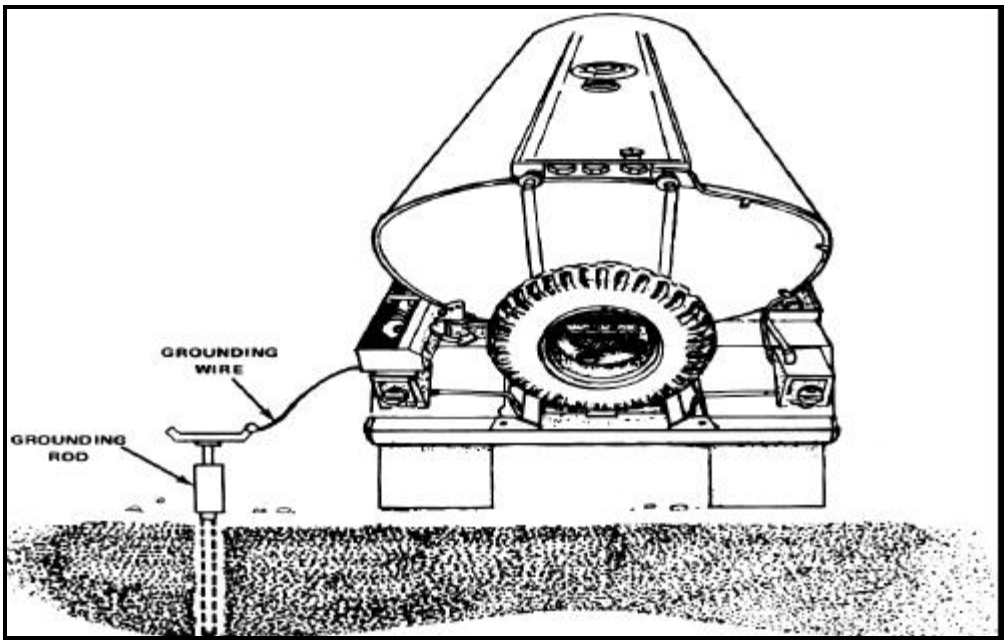

Figure 12-22. Grounding a tank vehicle

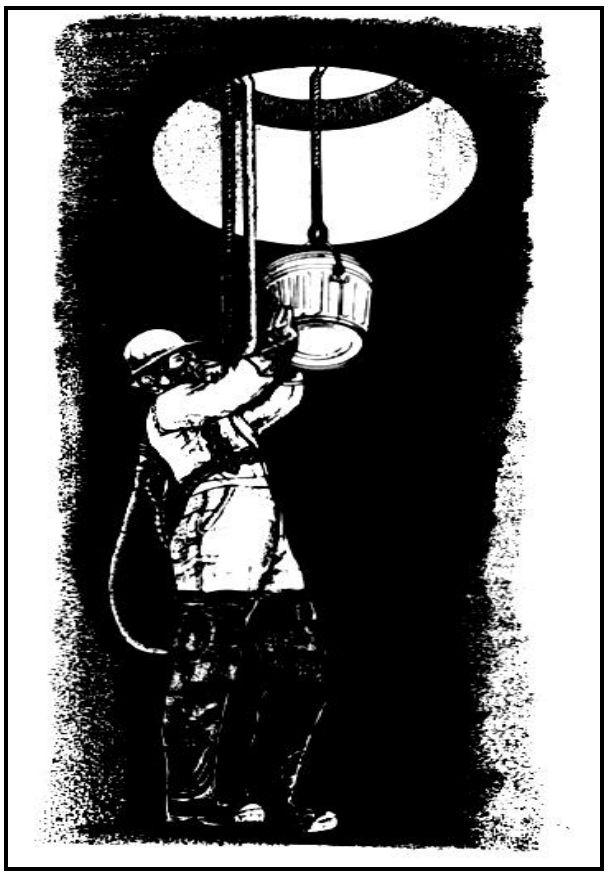

Figure 12-23. Removing sludge

CLEANING COATED TANK CARS

Some tank cars are coated on the inside to prevent rust. Never use steam to vapor free and clean a coated tank because steam can damage the coating badly. To vapor free and clean a coated tank car--

- Move the tank car to a bypass or spur track. Set the brakes. Lock derails in place at each end of the tank car. Chock the wheels as an added measure.
- Remove all sources of ignition. Check the rails under the car for correct bond and ground.
- Post warning signs.
- Drain all the fuel from the tank car.
- Remove the dome cover.
- Mount an air ejector or eductor in the dome to drain fuel vapors out of the car by suction. The air ejector may be powered by steam or compressed air. Bond the unit to the tank before operating it.
- Operate the air ejector until the tank is vapor free. Periodically, stop to test for fuel vapors with an explosimeter.
- Place a container under the tank car to catch sludge, solvents, and oily water after vapor-freeing operations are finished.
- Open the tank outlet.
- Use a wooden scraper to loosen sludge and to put it in a bucket. Do not use metal tools. Lift the bucket out through the dome and dispose of the sludge in a way that will not harm the environment.
- Use a bristle scrub brush to clean the walls and bottom with solvent. Do not use steel wool, wire brushes, or abrasive cleansers which could damage the tank coating.
- Rinse the walls and floor down with warm water.
- Wipe the inside dry with lint-free rags.